Research and Technology Objectives and Plans

SUMMARY

NASA
National Aeronautics and Space Administration

FISCAL YEAR 1981 RESEARCH AND TECHNOLOGY PROGRAM

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INTRODUCTION

This publication represents the NASA Research and Technology program for FY 1981 It is a compilation of the "Summary portions of each of the RTOPs (Research and Technology Objectives and Plans) used for management review and control of research currently in progress throughout NASA The *RTOP Summary* is designed to facilitate communication and coordination among concerned technical personnel in government, in industry, and in universities We believe also that this publication can help to expedite the technology transfer process

The *RTOP Summary* is arranged in five sections The first section contains citations and abstracts of the RTOPs Following this section are four indexes Subject, Technical Monitor, Responsible NASA Organization, and RTOP Number

The Subject Index is an alphabetical listing of the main subject headings by which the RTOPs have been identified

The Technical Monitor Index is an alphabetical listing of the names of individuals responsible for the RTOP

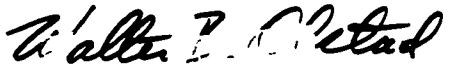
The Responsible NASA Organization Index is an alphabetical listing of the NASA organizations which developed the RTOPs contained in the Journal

The RTOP Number Index provides a cross-index from the RTOP number assigned by the NASA responsible organization to the corresponding accession number assigned sequentially to the RTOPs in *RTOP Summary*

As indicated above, responsible technical monitors are listed on the RTOP summaries Although personal exchanges of a professional nature are encouraged, your consideration is requested in avoiding excessive contact which might be disruptive to ongoing research and development

Any comments or suggestions you may have to help us evaluate or improve the effectiveness of the *RTOP Summary* would be appreciated These should be forwarded to

National Aeronautics and Space Administration
Office of Aeronautics and Space Technology
Washington, D C 20546
Attn Edmund L Sanchez, Acting Director
Resources and Management Systems Division (RM-3)



Walter B Olstad
Acting Associate Administrator for
Aeronautics and Space Technology

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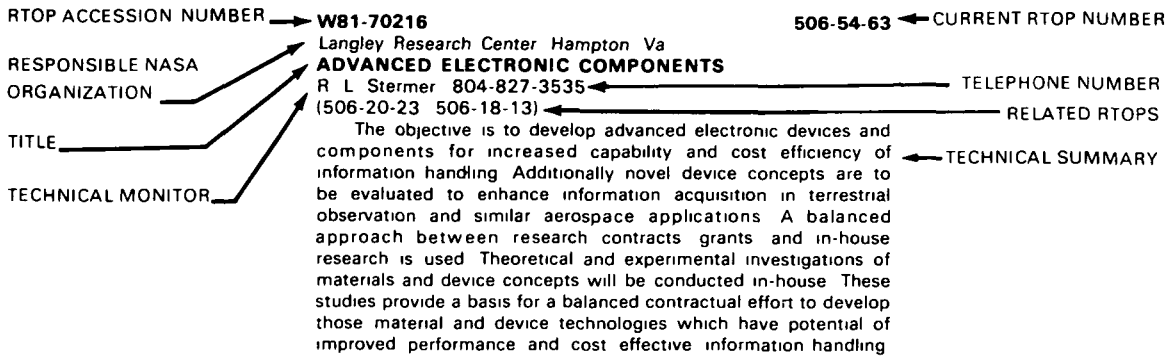

RESEARCH AND TECHNOLOGY OBJECTIVES AND PLANS

a summary

FISCAL YEAR 1981

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

Aeronautics Research and Technology Base

Aerodynamics Research and Technology

W81-70001 **505-31-11**
Ames Research Center Moffett Field Calif
COMPUTATIONAL METHODS AND APPLICATIONS IN FLUID DYNAMICS
V L Peterson 415-965-5265
(506-51-11)

The overall objective is to develop the capability for predicting complete aerodynamic characteristics of given aircraft shapes and designing new configurations aerodynamically optimized for specific missions to a degree that preliminary concepts can be developed evaluated and screened with less time cost and wind tunnel tests New mathematical methods languages and compilers will be constructed to realize the most effective use of available computer resources Computer programs will be developed to simulate turbulence and to solve complex fluid dynamics problems for the complete spectrum of flight speeds from low subsonic transonic to hypersonic and for steady and unsteady inviscid and viscous flow over two- and three dimensional configurations Fundamental experiments will be performed to verify these codes and to provide the necessary turbulence models The Reynolds number domain will extend from conventional wind tunnel conditions to full scale flight conditions for present and future aircraft The timely transfer of advanced computational aerodynamics technology to the aerospace community will be implemented by developing and disseminating computer codes applicable to practical aerodynamics problems

W81-70002 **505-31-13**
Langley Research Center Hampton Va
COMPUTATIONAL FLUID DYNAMICS
J C South Jr 804-827-2627
(534-02-13 505-31-33 505-31-23)

The purpose of this research is to provide the fundamental computational methods required for calculating complete aerodynamic characteristics of complex aircraft shapes and for optimizing aircraft shapes for a given mission The primary emphasis will be basic research in numerical and analytical methods coupled with large-scale computers Most computer codes developed in this plan will be of the pilot code class when a method or code is proven as a useful preliminary tool further developments of the codes for more complex configurations will be supported by RTOPs which are applications oriented such as ACEE and EET Research includes viscous and inviscid flow methods for all speed ranges with near term emphasis on the subsonic-transonic range The main interest is in large nonlinear problems studies include acceleration of iterative methods for large systems of finite difference equations mesh generation methods turbulence modeling and algorithms suitable for vector processor computers such as STAR and CRAY

W81-70003 **505-31-21**
Ames Research Center Moffett Field Calif
TURBULENCE AND MODELING
L L Presley 415-965-5859
(505-31-51 505-31-31 505-31-41)

The objective is to conduct analytical and experimental studies into complex turbulent flow fields Specifically turbulent flows interacting with shock waves highly curved bodies and general three dimensional surfaces are considered Emphasis is placed on obtaining detailed and accurate experimental data that can be used to guide the development of mathematical models for turbulent structures These mathematical models will subsequently be used to develop fast efficient methods for the prediction of both attached and separated turbulent flows

W81-70004 **505-31-23**
Langley Research Center Hampton Va
TURBULENT DRAG REDUCTION
D M Bushnell 804-827-4546
(505-31-13)

Research to significantly improve our ability to predict and control the behavior of turbulent shear flows including boundary layers free shear layers and recirculating/vortex flows Theoretical and experimental research to (a) reduce turbulent skin friction drag (b) control stream disturbances in transonic/supersonic/hypersonic tunnels (c) determine sensitivities of laminar boundary layer transition process for application to laminar flow control and (d) improve understanding of physics/structure of turbulent shear flows and turbulence modeling for computational fluid dynamics Drag reduction research investigates moving/compliant walls fixed transverse and longitudinal surface waves and large eddy breakup devices primarily for eventual CTOL transport application Free stream turbulence research develops stagnation chamber treatments and laminar flow and rapid expansion nozzles to improve validity of wind tunnel measurements especially for data where transition and flow separation are present Detailed boundary layer transition studies with controlled input disturbances determine sensitivity of laminar flow control techniques to operational factors such as engine noise suction surface blockage and surface irregularities Detailed experiments using hot wires LV/Ramen Rayleigh scattering and resonant Doppler systems provide data for development and validation of turbulence closure models in three dimensional boundary layers three dimensional free mixing and corner/recirculating/vortex flows

W81-70005 **505-31-31**
Ames Research Center Moffett Field Calif
AIRFOIL AND WING DEVELOPMENT
L L Presley 415-965-5859
(505-31-21 505-31-41 505-31-51)

The objective of this RTOP is to conduct research that will lead to the development of a technology base for the design of advanced airfoils and wings The scope of the research encompasses both unsteady and steady flow about single element airfoils and steady flow about multi-element airfoils The single element airfoil program has three main elements (1) development of advanced computational codes for optimum airfoil design (2) development of adaptive wall technology for airfoil and wing testing and (3) theoretical and experimental study of transonic flow about oscillating airfoils The multi-element airfoil program is focused around coordinated experimental studies which will provide data required for guidance and verification of theoretical work directed toward the analysis of the subsonic viscous flows around multi-element airfoils and wings that are equipped with high lift devices Emphasis will be placed on merging turbulent shear layers experimental studies of turbulent separated flow and the analysis of the three-dimensional flow over finite wings equipped with leading-edge flaps and trailing-edge flaps

W81-70006 **505-31-33**
Langley Research Center Hampton Va
AIRFOIL DEVELOPMENT
R W Barnwell 804-827-4514

The Airfoil Aerodynamics program is to provide analytical methods and computer codes coupled with experimental procedures and test facilities for the design and development of airfoils and airfoil systems in both steady and unsteady flows and to employ these tools in the development of advancedtechnology single- and multi-element airfoils for all classes of aircraft The applications include propeller sections and airfoils for fixed- and rotory-wing aircraft and involve the subsonic and transonic speed regimes and laminar and turbulent boundary layers The program includes (1) the generation of precise theoretical and rapid engineering analysis and optimal-design methods which have been verified through appropriate selected experiments (2) the development of new and improvement of existing airfoil research facilities to improve the range and validation of two-dimensional data and (3) the generation and documentation of the aerodynamic behavior of new families of airfoils airfoil controls and high-lift systems by the use of both theory and experiment in support of U S industry and DOD to satisfy specific and special-purpose airfoil needs

W81-70007 **505-31-41**
Ames Research Center Moffett Field Calif
AERODYNAMIC THEORY/EXPERIMENTAL INTEGRATION
L L Presely 415-965-5851

The objective of this research is to expand the aerodynamic technology base and provide a basic understanding of the aerodynamic flow fields about complete wingbody-tail configurations as well as individual components through the useful angle-of-attack range and from subsonic through supersonic Mach numbers This is being accomplished by the development of new theoretical methods and by the integration of theory and experiment to yield a more complete understanding of the aerodynamic phenomena The primary theoretical methods under development include a transonic wing-body-tail code using the full potential equations and an advanced linear panel code applicable to both subsonic and supersonic flow In addition methods will be developed to combine various calculation techniques to predict more complex flows such as jet induced effects or to numerically optimize aircraft components The integration of theory and experiment includes the development of techniques to rapidly compare calculated and measured results and to integrate theoretical and experimental procedures to provide a more complete definition of the aerodynamic characteristics

W81-70008 **505-31-43**
Langley Research Center Hampton Va
CONFIGURATION AERODYNAMICS
R T Whitcomb 804-827-2252
(534-02-13)

The technical objective of this research primarily is to increase the technology for the development of practical means for improving the aerodynamic performance of high subsonic and supersonic aircraft through the generation and application of an expanded experimental data base and the development and evaluation of improved theoretical and emperical design and analysis methods Also, technology relative to minimizing trailing vortex induced turbulence will be developed The expansion of the experimental data base will be accomplished through parametric wind tunnel tests guided by theoretical analyses with emphasis on favorable interference of multiple lifting surfaces interacting vortex flows and vortex lift optimization favorable interference lift by proper integration of the propulsion system with the airframe development of improved high aspect ratio supercritical wing and wing-winglet configurations and efficient under-the-wing propulsion system insttallations supercritical flow investigation of swept forward wings and application of variable geometry concepts Improved analysis methods for both attached flow and vortex flow concepts methods for predicting complete surface aerodynamic load distribution with emphasis on critical aerodynamic and structural design conditions involving edge separation induced vortex flows will be developed Further theory and experiment will be used to investigate high lift systems for landing and takeoff and means for increasing the off-design performance of configurations with high cruise efficiency 22

W81-70009 **505-31-44**
Hugh L Dryden Flight Research Center Edwards Calif
AERONAUTICS FLIGHT EXPERIMENTS
T R Sisk 805-258-3311

The objective of this RTOP is to provide a continuing research and development effort into the problems associated with the fundamental understanding of fluid and flight mechanics with special emphasis on the relationship to large-scale vehicles operating in a real world environment free of interference effects These efforts include experimental aerodynamic studies to improve our ability to predict the efficiency of vehicles moving through the atmosphere and to define the effects of Reynolds number surface condition excrescences and local and freestream flow conditions on lifting surfaces and complete configurations Also included will be investigations in support of or verification of wind-tunnel studies Experimental research pertaining to laminar and turbulent boundary layer phenomena and on the separation characteristics of turbulent flow over afterbodies will also be conducted as will analytical studies appropriate to support the fluid mechanics disciplines

W81-70010 **505-31-51**
Ames Research Center Moffett Field Calif
AERODYNAMIC TEST METHODS AND INSTRUMENTATION
G Lee Steinle 415-965-5861

The general objective of this research is to provide the technology for increased ground-based aerodynamic experimental research capability required to improve prediction of performance and flight characteristics of conceptual or new aircraft designs and the exploration of advanced aerodynamic concepts Tunnel wall constraints flow quality and means for simulating higher Reynolds number flow will be investigated analytically and experimentally to improve the quality of test results To improve the state-of-the-art in non-intrusive measurement capability advanced laser velocimetric and holographic instrumentation systems will be developed to obtain fundamental fluid mechanic measurements such as mean velocities turbulence intensities and Reynolds stress components Infrared camera technology will be explored as a means of locating shock-waves and regions of separation on wind tunnel models

W81-70011 **505-31-53**
Langley Research Center Hampton Va
EXPERIMENTAL METHODS AND INSTRUMENTATION
R A Kilgore 804-827-3711

The technical objective is to provide the technology for increased ground-based aerodynamic experimental research capability required to improve our ability to predict the performance and flight characteristics of conceptual or new aircraft designs and to permit the exploration of advanced aerodynamic concepts In-house contract and grant research will be used to advance the state-of-the-art with regard to (1) cryogenic wind tunnel research technology (2) magnetic suspension and balance systems (3) transonic tunnel wall interference (4) improved instrumentation techniques and (5) advanced sensors

W81-70012 **505-31-54**
Hugh L Dryden Flight Research Center Edwards Calif
FLIGHT RESEARCH INSTRUMENTATION DEVELOPMENT
K F Anderson 805-258-3311

This program will investigate and develop new and improved research flight test measurement capabilities which will more accurately and productively collect flight test data An inertially based integrated sensor system a miniaturized multichannel pressure sensor system and a high accuracy fuel flow meter are to be developed

W81-70013 **505-31-63**
Langley Research Center Hampton Va
FULL SPACE REYNOLDS NUMBER TEST TECHNOLOGY
L W McLinney 804-827-2961

The technical objective is to develop the test technology required to fully exploit the unique capabilities of the new pressurized cryogenic wind tunnels in the performance of research and development studies related to advanced aerodynamic design concepts at full scale Reynolds numbers This objective will be accomplished utilizing in-house contract and grant research to (1) extend development of cryogenic technology and full-scale Reynolds number techniques to insure maximum utilization of the unique research and development capabilities of new Langley National Transonic Facility (2) continue development of technology requirement for sound engineering of models for the high pressure cryogenic environment including establishment of model criteria and (3) provide instrumentation and measurement techniques capable of operating over a wide temperature range with emphasis on minimizing measurement error and time required for minimizing measurement error and time required for data collection

W81-70014 **505-31-70**
Langley Research Center Hampton Va
POST-SPILL LIQUID HYDROGEN BEHAVIOR
R D Witcofski 804-827-3838

The objective will be to provide the technology for predicting the behavior and character of relatively large quantities of *spilled liquid hydrogen the vapor which subsequently forms and* any resultant deflagration or detonation The approach will be to define what are considered to be credible liquid hydrogen spills and to develop analytical models for adequately describing the several phenomena with the modeling guided and validated by appropriate experiments Key issues will be addressed in a logical sequence to establish early the severity of the hazards problems and the range of variables to be included Phenomena include the vaporization rate of liquid hydrogen when spilled onto various surfaces (e g soil concrete) the time-history character and behavior of the vapor cloud formed as a result of spills and the deflagation and detonation characteristics of hydrogen-air-cloud mixtures Both in-house and contractual efforts will be required

W81-70015 **505-31-83**
Langley Research Center Hampton Va
APPLIED MATHEMATICS
W D Erickson 804-827-2471

This RTOP provides for the conduct of basic research in applied mathematics and computer science The research is carried out by a combination of in-house efforts university research grants and the continuing operation of the Institute for Computer Applications in Science and Engineering (ICASE) located at the Langley Research Center The in-house and grant efforts include research dealing with numerical solutions of differential and algebraic systems data analysis computer graphics symbolic and algebraic manipulation data base management programing languages microprocessor software and software engineering The broad research areas pursued in ICASE include Numerical Analysis Boundary Conditions Application of Computational Techniques and Applied Computer Science

Propulsion Research and Technology

W81-70016 **505-32-01**
Ames Research Center Moffett Field Calif
NOISE REDUCTION TECHNOLOGY FOR SHORT-HAUL AIRCRAFT
D H Hickey 415-965-5036

The work described in this RTOP will provide the technology for the reduction of noise of short-haul aircraft and will provide through wind tunnel measurements large-scale data on relative velocity effects on noise of modern turbofan and turbojet engines The FY-81 jet noise program includes the reporting of flight effects on the jet noise of a modified viper engine with mechanical suppressors further analysis of this and other data theoretical studies and completion of the joint programs with *ONERA on the development of wind tunnel techniques for noise* testing Work on flight effects on fan noise will continue with analysis of the results from tests of a JT15D engine with instrumented fan rotor Studies of specific short-haul noise sources will begin The studies will include wall jets the effect of high loading gradients and propeller installation effects Work on improved mechanization of flow measuring techniques will continue

W81-70017 **505-32-02**
Lewis Research Center Cleveland Ohio
PROPULSION NOISE RESEARCH
C E Feiler 216-433-6189

The objectives of this RTOP are to provide data and a technology base for reducing aircraft propulsion-generated and associated noise with minimum weight performance and economic penalties and to develop techniques for accurate prediction of noise levels of operating and future aircraft The generation and propagation of noise from all engine sources both internal and external are addressed These include the turbomachinery (fan compressor turbine) core engine (combustor internal surfaces) and the jet noise Acoustic suppression (duct treatment) is a major element of the work The work is distributed among basic research that provides knowledge of the fundamental principles and phenomena present in noise generation and propagation applied research that explores concepts and provides a data base and demonstration of technology on full scale engine systems In-house activities are balanced by a few contractual programs including university grants In-house facilities include the Engine Fan and Jet Noise Facility (W-2) for model fan and jet experiments several hot and cold flow jet rings one outdoor engine stand capable of full scale engine tests including thrust performance and a small laboratory flow duct apparatus Forward velocity experiments are conducted in the 9x15 low speed wind tunnel

W81-70018 **505-32-03**
Langley Research Center Hampton Va
PROPULSION NOISE RESEARCH
H H Hubbard 804-827-3577
(505-35-13 505-41-43 535-03-13 505-33-53 532-06-13)

The objective of this research is to provide a data and technology base for reducing aircraft propulsion generated noise with minimum weight performance and economic penalties and *to develop techniques for accurate prediction of ground noise* levels of operating and future aircraft Both theoretical and experimental noise reduction and control studies are involved

and work will be accomplished in-house and by grants and contracts Emphasis in the experimental portion of the program is on laboratory and scale model experiments under closely controlled conditions with supplemental acoustic range and flight vehicle studies for validation theoretical methods and calculations of the sound fields inside ducts with airflow with varying geometry and with and without acoustic liners forward motion effects on inlet noise understanding of jet shear noise and shock cell noise generation and propagation through analytical studies and precision measurements jet shielding of jet noise identification and location of sound sources in flow fields noise generation by viscous flow fields atmospheric propagation including refraction and scattering development and validation of procedures for predicting single event flyover noise exposures from general aviation and CTOL aircraft and helicopters and development of advanced methods of noise measurement and analysis

W81-70019 **505-32-05**
Jet Propulsion Laboratory Pasadena Calif
BASIC NOISE RESEARCH
Paul F Massier 213-354-3549

The general objectives of this RTOP are (1) to advance the understanding of the fundamental fluid mechanics phenomena associated with noise production and noise transmission in jets and (2) to conceive methods of modifying the fluid mechanics that will reduce the noise radiated from jets More specifically the objectives for FY-81 are to determine the cause of the excess noise and of the jet oscillations that occur in an underexpanded supersonic jet under flight conditions to advance the understanding of the manner in which a flowing air stream *surrounding a jet interacts with the jet and changes the radiated* noise both for a free inverted velocity profile supersonic jet and for a jet ejector and to evaluate the effectiveness of jet noise shielding of two or more nearby jets Experiments of supersonic subsonic and coannular jets are performed at temperatures between 70 degrees F and about 2000 degrees F These studies are conducted in an anechoic chamber Simulated flight conditions are established by supplying coannular flow around the primary nozzle Velocity distributions in the jets are determined from measurements of pressures and temperatures obtained with probes Shadowgraph and Schlieren photographs are taken for visualization analysis High-speed (7000 frames/sec) Schlieren movies are also obtained As an example the high-speed Schlieren movies synchronized with signals received by microphone and hot-wire sensors have been used to determine the significance of the pairing process of large-scale turbulent structures on the generation of noise Microphones ane used in the near-field outside the jet and in the far field to evaluate radiated noise Nitrogen helium argon and other gases of different molecular weights are expanded through coannular nozzles to evaluate the effect of density on inverted velocity profile jets

W81-70020 **505-32-12**
Lewis Research Center Cleveland Ohio
INLET NOZZLE AND PROPELLER RESEARCH
D N Bowditch 216-433-4000

Improved analytical and experimental design methodology for inlets nozzles and propellers will be generated to achieve higher performance with increased propulsion system stability Computer analysis programs for predicting internal and external flows will be synthesized in-house and by contracts and grants These programs will make it possible to analyze viscous and inviscid flows in two and three dimensions Basic benchmark testing will be done to define detailed flow phenomena to guide and verify the analysis Verification experiments will be conducted to verify accuracy of computer codes for design of actual components Inlet nozzle and propeller hardware will be designed and used to conduct exploratory research in areas that are not presently amenable to analysis A counter rotation propeller research program will be initiated which will include development of analysis and analysis verification by comparison with test results

W81-70021 **505-32-13**
Langley Research Center Hampton Va
PROPULSION SYSTEM INTEGRATION
W P Henderson 804-827-2676

Fundamental studies will be conducted to develop an improved understanding of the flow phenomena associated with the integration of the propulsion system into advanced aircraft concepts Through this research propulsion system integration concepts will be studied that are designed to exploit favorable interference effects which may enhance the wing lift reduce drag or permit thrust reversing of the exhaust sytem to improve performance of the aircraft For the exhaust nozzle investigations will be made to determine means of improving the internal and external performance of both uninstalled and installed nozzles and to explore the integration procedures for incorporating the exhaust system into the fuselage wing or pods General experimental and theoretical research studies will be conducted to improve the understanding of the flow phenomena associated with nozzle/boattail/jet/empennage and inlet/fuselage Advanced analytical methods capable of predicting the propulsion system integration effects will be developed These methods will vary from the simpler faster patched methods to the more complex Navier-Stokes solutions Experimental research on inlets and nozzles will be conducted for correlation with analytical results and design procedures will be developed from this information

W81-70022 **505-32-22**
Lewis Research Center Cleveland Ohio
FAN, COMPRESSOR AND TURBINE RESEARCH
C L Ball 216-433-6835
(505-32-52 510-55-11 535-01-12)

Approaches to improve efficiency operating range distortion tolerance durability and reliability and to reduce weight volume and cost of the wide variety of fans and compressors required for advanced propulsion systems will be investigated The objective of the turbine program is the attainment of increased life and improved performance through improved turbine cooling and aerodynamic design methods for both axial and radial flow turbines Increased emphasis is placed on verifying and demonstrating the capability of internal flow analysis codes for improving the accuracy and reliability of compressor and turbine design systems Accuracy and reliability of design systems and performance prediction methods are improved through more accurate modeling of stage internal flows The advanced analytical methods will result in large cost savings by reducing both the time required and risk involved in incorporating advanced components into future engine development program The work is conducted through in-house contract and university grant efforts

W81-70023 **505-32-32**
Lewis Research Center Cleveland Ohio
COMBUSTION AND EMISSIONS REDUCTION RESEARCH
D A Petrash 216-433-6860
(505-32-72 511-55-12)

The objective of the work to be conducted under this RTOP is to evolve and demonstrate the technology required to develop combustors and thrust augmentors for advanced civil and military aircraft engines that will provide improved performance greater durability wider operating range and reduced engine exhaust pollutant emissions The activities in this RTOP include both basic and applied combustion and emissions research and technology for advanced high performance low pollutant combustors Fundamental combustion studies will be conducted in flame-tube type facilities to gain a better understanding of combustion processes and pollutant formation processes Applied combustion research investigations will be conducted in segment sector and full-scale annular test facilities and will be aimed at providing design tools for the design of future advanced gas turbine engine combustion systems As appropriate studies will be undertaken to evaluate and verify the adaptation of this advanced combustion and pollutant reduction technology to modern aircraft engines

W81-70024 **505-32-42**
Lewis Research Center Cleveland Ohio
POWER TRANSFER RESEARCH
W J Anderson 216-433-4000
(506-53-12 505-43-32 511-58-12)

The objectives of this work are to advance the state-of-the art in tribological science and in the technology of mechanical components such as bearings shaft seals gas path seals gears shafts lubricants and lubrication systems Goals are to achieve improved component performance life reliability and efficiency in the high temperature high speed and high pressure environments of turbojet and turbopropeller engines and mechanical power transmission systems Emphasis will be given to an interdisciplinary approach to tribological science to create far term opportunities as well as to satisfy near term goals for both improved component and system performance Analytical techniques for balancing determining and controlling the dynamic behavior of rotating assemblies (shafts bearings dampers seals and aerodynamic components) will be developed and corroborated experimentally to provide better design tools for high speed rotating machinery

W81-70025 **505-32-52**
Lewis Research Center Cleveland Ohio
COMPUTATIONAL FLUID MECHANICS FOR TURBOMACHINERY
M J Hartmann 216-433-6906
(505-32-52 510-55-12)

The objective of the computational fluid mechanics program for turbomachinery is to develop understanding and modeling ability for fundamental internal flow performance and to develop analytical and computational analyses to simulate and predict the steady and unsteady flow conditions in advanced fans and compressors and cooled turbines Experiments are conducted for the generation of flow models and for code verification The analysis methods are developed into practical codes for use on NASA and industrial computers Specific objectives include the following originate develop and improve analyses for prediction of both aerodynamic and aeroelastic flow effects in advanced fans compressors and cooled turbines develop new analytical and numerical techniques and models for incorporation into advanced codes build analysis tools into a practical highly useful analysis/design system through improvements and integration incorporate extensive graphics into the analysis codes to maximize understanding of the results develop methodology to enable the user to more rapidly cover the range of all the parameters in the analysis space investigate the use of advanced computers for some of the longer running codes conduct basic experiments to obtain data for the modeling of flows and for code verification and verify models and codes against this experimental data The work is conducted through in house contract and university grant efforts

W81-70026 **505-32-62**
Lewis Research Center Cleveland Ohio
ENGINE DYNAMICS AND CONTROLS RESEARCH
R G Willoh 216-433-6624

The objective is to improve the understanding of propulsion system behavior and to provide an improved technology base for future engine system development Experimental and analytical efforts are undertaken to support the various technical disciplines associated with the dynamic behavior and control of propulsion systems The approach in the system dynamics areas is to conduct research subprograms on advanced civil and military engines Particular emphasis is placed on the dynamic interaction problems encountered when the individual components are combined to form an engine system Subprograms include investigations into the effects of distortion on system stability stall recovery and the effects of various disturbances on system dynamic behavior performance Studies will also be made of new component and system technology for improving fuel efficiency and experimental and analytical research will be conducted to define engine system behavior in the higher frequency ranges (greater than 50-Hz) Control theories and concepts are developed and applied to achieve improved performance safety, and reliability Special control hardware such as servos sensors and actuators are developed as required Dynamic analysis simulation and experiments are performed to validate the control theories concepts and hardware

W81-70027 **505-32-72**
Lewis Research Center Cleveland Ohio
FUELS RESEARCH
J Grobman 216-433-6229
(505-32-32 511-55-12 511-59-12)

The potential properties of future aviation turbine fuels derived from both petroleum and nonpetroleum sources such as oil shale and coal will be determined by analytical and experimental synthesis and characterization techniques The effects of these fuels which may have broader properties than currently required on the performance and durability of jet engine components and materials will be determined Sufficient quantities of these fuels must be procured and/or simulated by blending of petroleum-based fuels and will be used to conduct research tests required to evolve the technology that may be needed to use these fuels in current and future jet aircraft engines A joint program has been organized between the AFWAL and Lewis to implement an overall integrated effort to best utilize the technical capabilities of both organizations The program includes both fundamental and applied research activities conducted in-house under grants to universities and under industry contracts Overall coordination with other government agencies such as the USN DOE EPA and with industry will also be maintained in order to provide proper direction and scope to the program as it develops and proceeds

W81-70028 **505-32-82**
Lewis Research Center Cleveland Ohio
PROPULSION INSTRUMENTATION RESEARCH
N C Wenger 216-433-6646

The programs under this RTOP are directed at developing and demonstrating the technology required for significantly advancing the state of the art in propulsion instrumentation The RTOP focus is on both operational instrumentation for propulsion systems and R and D type instrumentation for component development and tests The activities in these programs include fundamental studies of basic phenomena that relate to instrumentation the design development and demonstration of prototype sensors and instruments and the development and automation of large facility type instrument systems Programs are directed toward developing the following High temperature transducers and high temperature electronic devices for use in instrumentation systems for future controls engine monitoring systems and R and D applications a wide variety of sensors (surface temperature heat flux strain etc) for measuring critical propulsion system component parameters particularly those required for hot section durability studies and a number of laser based coherent optical techniques (laser anemometry holography etc) for measuring detailed flows in a variety of situations that are required for verifying computational fluid mechanics models

W81-70029 **505-32-92**
Lewis Research Center Cleveland Ohio
ADVANCED ENGINE SYSTEM CONCEPTS
R J Weber 216-433-4000

New or improved analytical techniques will be derived for estimating the cycle performance weight and other characteristics of advanced engines Also studies will be performed of new approaches to the design of components or complete engines that will yield better performance

W81-70030 **505-32-93**
Langley Research Center Hampton Va
HYPERSONIC PROPULSION RESEARCH
R A Jones 804-827-3772

Program is aimed at developing an understanding of the fundamental process of mixing and combustion in supersonic flows for application to airframe-integrated airbreathing propulsion systems from Mach 3 to Mach 10 Theoretical and experimental studies are conducted in fuel injection turbulent mixing of fuel and air subsonic and supersonic combustion and three dimensional turbulent reacting flows in ducts of complex geometry having lateral pressure gradients in order to advance methodology

for design and performance prediction techniques Component investigations are conducted in Langley facilities on inlets which may be applicable to several types of engines and combustor and nozzles for modular scramjet engine concepts Research on subscale boilerplate engine modules is conducted at conditions simulating flight at Mach 4 and Mach 7 conditions in Langley propulsion facilities The in house research is augmented in several areas by R and D grants and contracts This program is focused on providing the basic technology for lightweight fixed geometry airframe-integrated scramjet engine modules using a dual mode of H2 fuel injection to control mixing and combustion over a wide range of flight speeds This technology will be applicable to efficient propulsion for either cruise aircraft accelerating and maneuvering aircraft airbreathing space launch vehicles or with hydrocarbon fueled high speed highly maneuverable missiles

Materials and Structures Research and Technology

W81-70031 **505-33-12**
Lewis Research Center Cleveland Ohio
METALLIC/CERAMIC MATERIALS
Hubert B Probst 216-433-4392
(506-53-12 510-53-12 510-57-12 505-32-92)

The objective of this RTOP is to provide the technology base for improved materials (alloys coatings and ceramics) and processes for use in advanced air breathing propulsion systems particularly for aeronautical applications The RTOP has two major program elements high temperature materials and environmental protection In both elements materials and processes are sought that offer improvements on technical performance and economy in terms of total life cycle costs In the high temperature materials portion the classes of materials investigated include oxide dispersion strengthened alloys single crystals fiber reinforced superalloys powder metallurgy superalloys superalloys of low strategic material content and advanced ceramics in the Si3N4 and SiC families Specific phenomena such as creep fatigue crack propagation grain growth and sintering are studied In the environmental protection portion of the RTOP corrosion protective coatings and thermal barrier coatings and coating processes are investigated The phenomena of oxidation hot corrosion erosion their interactions and ultimate effect on coating/alloy system life are studied In both program elements basic research is conducted in house and by university grants Results of these basic efforts provide guidance for the more applied work conducted in house and by industrial contracts Emphasis is on materials and processes relevant to aircraft gas turbine blade vane disk and seal applications Ultimately promising materials and processes become candidates for the MATE program

W81-70032 **505-33-13**
Langley Research Center Hampton Va
ADVANCED ALUMINUM ALLOYS
Bland A Stein 804-827-3354
(505-33-23)

The objectives of this RTOP are to identify thermomechanical processes for improvement of mechanical properties and durability of advanced aluminum alloys through basic understanding of the microstructural behavior and to demonstrate the advantages of these materials for commercial transport applications The results of thermomechanical process development on advanced whisker-reinforced powder metallurgy and lithium-bearing ingot-metallurgy aluminum alloys will be evaluated in fatigue fracture and selected environmental degradation tests and by metallurgical analysis of coupon specimens and structural subelements The technology from this program will permit significant reductions in mass and improved durability and integrity of commercial transport aircraft structures while retaining conventional aluminum alloy component fabrication technology

W81-70033 **505-33-21**
Ames Research Center Moffett Field Calif
FATIGUE DAMAGE AND ENVIRONMENTAL EFFECTS IN METALS AND COMPOSITES
H G Nelson 415-965-6137

An experimental and analytical program will serve as a basis for the development of reliable life prediction methods applicable to graphite/epoxy composite and metallic aerospace structural materials For composite materials a modification of the time temperature superposition principle (often used to describe the time dependent behavior of elastomers) is applied to the behavior of complex laminates through the use of a lamination theory Using a similar superposition approach the correspondence between stress moisture temperature and time are being established with the ultimate goal of the development of an accurate constitutive relationship The ranges of applicability of this mechanics approach are being established through mechanistic investigations For metallic materials three different approaches to life prediction are used which correspond to the three stages of fracture crack initiation subcritical slow crack growth and rapid unstable failure A statistical approach is used for crack initiation for this is a somewhat random process Factors being considered are mode of loading the environmental influence and metallurgical parameters both independently and together (potential synergistic influences) Kinetic characterization of the slow crack growth stage of fracture is being accomplished through the application of fracture mechanics techniques The rate processes will be identified which control slow crack growth such that the limits of applicability can be established and the kinetics of the process may be hindered Unstable rapid fracture is being characterized through the application of elastic-plastic fracture mechanics

W81-70034 **505-33-22**
Lewis Research Center Cleveland Ohio
LIFE PREDICTION
Marvin H Hirschberg 216-433-4000
(510-57-12)

The major objective is to obtain a better understanding of the fatigue and fracture behavior of materials and to develop and verify methods for predicting the life of aerospace structures and components of propulsion systems when subjected to complex time dependent patterns of temperatures and cyclic loads

W81-70035 **505-33-23**
Langley Research Center Hampton Va
LIFE PREDICTION FOR COMPOSITE MATERIALS
Robert T Swann 804-827-2969
(505-33-33 533-01-13 506-53-23)

The objective of this research is to develop the capability to predict the useful lifetime of composite materials in aircraft service environments Goals of the research include formulation of a suitable theoretical framework for life prediction, experimental validation of the concepts involved and development of the ideas and the instrumentation needed for inspection and damage identification Studies will be undertaken to identify and characterize damage and damage growth mechanisms The more basic studies include precise experiments to clarify the processes involved in damage and fracture as well as tests designed to establish the physical basis for variability in material properties through ultrasonic techniques The understanding acquired in these studies will be used to develop tests which characterize impact damage and impact resistance of composite materials Effects of moisture and other environmental constituents on bulk material and bonded joints will be determined and validated accelerated test techniques will be developed Simple specimens will be tested to determine the sensitivity of fatigue life to the loads in transport aircraft load spectrum and results of these tests will guide the development of test spectra that will maximize the efficiency of large scale tests

W81-70036 **505-33-31**
Ames Research Center Moffett Field Calif
FIRE RESISTANT MATERIALS
A H Heimbuch 415-965-6274
(505-44-21 534-05-11 534-03-11)

Research will be performed to provide tough thermally stable and fire resistant polymers to serve as candidate materials for a variety of applications in the aerospace field The main emphasis is to design polymers for use in primary and secondary composite structures transparent films and windows foams and adhesives Objectives include the development of new matrix resins and improved fibers which will be used for the preparation of advanced composites for aircraft structures The control of electrical conductivity in modified carbon fibers for use in composites will also be studied with an extension of the study toward photovoltaic materials The use of polymer grafts and copolymer blends will be investigated as possible approaches to the development of better matrix resins for composites of high fracture toughness Polymers to be investigated for resin matrix systems include modified polystyrylpyridine (PSP) fluorene-modified epoxies phenolic novolac and resole modified bismaleimides and the aromatic polyether etherketon (a tough thermoplastic) Polymers which are considered for photovoltaic doped systems include polyacetylene and polyparaphenylene-sulfide In addition computational chemistry will be applied to large atomic cluster arrays as models for polymeric macromolecules

W81-70037 **505-33-32**
Lewis Research Center Cleveland Ohio
COMPOSITES FOR PROPULSION COMPONENTS
Charles P Blakenship 216-433-6922
(505-33-62)

The overall objective of this research is to identify and evolve polymer matrix and metal matrix composite materials and processing technology with potential for aeropropulsion components having lower weight reduced cost and greater reliability Composites being considered include resin matrices reinforced with fibers of boron Kevlar glass graphite and aluminum matrices reinforced with fibers of boron alumina and graphite In the area of polymer matrix composites emphasis is placed on identifying processible high temperature resins, a methodology for chemical characterization of PMR polyimides and tougher matrix resins In metal matrix composites emphasis is placed on improving key composite properties such as impact resistance and on evolving low cost fabrication processes Potential applications for the composites technology include both static and rotating turbine engine components

W81-70038 **505-33-33**
Langley Research Center Hampton Va
COMPOSITES
N J Johnston 804-827-3041
(505-33-23 506-53-23)

The objective is to exploit the full weight reduction potential of highly loaded composite structures The approach is to improve matrix properties damage tolerant concepts analytical predictive methods and understanding of aging effects Structural resins and adhesives with improved toughness moisture resistance processability and thermal performance will be synthesized Fundamental factors which control toughness and damage tolerance in resins and composites will be determined Impact damage and residual strength will be measured and modeled mathematically Fatigue/fracture problems in full scale composite wing panels will be ascertained The effectiveness of bolted composite joints and woven buffer strips will be studied Using advanced structural concepts and design methods flat curved and stiffened structures will be made and tested in compression tension combined loads and after damage Analytical methods will be developed to predict properties Long-term durability under expected service environments will be studied using ground-based and flight service exposure Accelerated tests and predictive analytic methods will be emphasized Another objective is to lower costs and increase reliability by developing effective repair procedures and advanced processing and joining techniques

W81-70039 **505-33-52**
Lewis Research Center Cleveland Ohio
LOADS, DYNAMICS AND AEROELASTICITY
G V Brown 216-433-6920
(505-33-22 505-33-62 505-33-72)

The objective of this program is to develop improved methods of calculating loads stresses and deflections in aircraft turbine engines so that the structural design of an engine can be based more on design calculations and less on testing and rebuild procedures There has been a marked increase in speed and capacity of computers in recent years New methods will be developed under this program which can take advantage of these increased computer capabilities The approach will be to develop mathematical models of the engine These models will take into account both the interactions between components and provide a more comprehensive treatment of the internal degrees of freedom of these components Steady state and transient situations such as blade loss will be addressed The efficiency of special purpose computers with hard-wired solution algorithms for greatly increased speed and of graphical display methods to facilitate input and output of structures problems will be evaluated

W81-70040 **505-33-53**
Langley Research Center Hampton Va
LOADS, AEROELASTICITY, AND STRUCTURAL DYNAMICS
W H Reed III 804-827-2265

The objective is to develop and validate improved methods for the analytical determination of loads structural response and structural stability of aerospace systems considering the dynamic and aeroelastic characteristics of the systems and structural interactions with flight control subsystems and to use these methods in the development and evaluation of techniques for eliminating or minimizing flutter buffer noise and other undesirable response phenomena and for the enhancement of performance ride quality crash safety and service life Research will be conducted to provide more accurate unsteady aerodynamic theories particularly in the transonic range Advanced aeroelastic analysis methods will be evaluated and validated by both wind tunnel tests and flight tests using the DAST concept (Drones for Aerodynamic and Structural Testing) Emphasis will be on measurements of transonic aerodynamic loads and flight validation of active control systems for load alleviation and flutter suppression A decoupler-pylon concept for wing store flutter suppression will be evaluated in flight tests on a fighter airplane Basic wind tunnel flutter studies will be used to gain a better understanding of the flutter characteristics of advanced aerodynamic configurations Analysis/synthesis methods will be developed for use in design support of future aircraft with advanced features such as active controls and aeroelastically-tailored wings and empennage Improved methods for the analytical determination of structural response to noise will be developed and these methods will be used in the development and evaluation of techniques for minimizing noise transmission for the enhancement of ride quality Advanced analysis and synthesis capability for predicting and improving transport aircraft crashworthiness and occupant survivability will be developed

W81-70041 **505-33-54**
Hugh L Dryden Flight Research Center Edwards Calif
FLIGHT LOADS AND AEROELASTICITY
A L Carter 805-258-3311

This RTOP has three primary purposes (1) to study unsteady aerodynamic loads and flutter suppression at transonic speeds using an RPRV aircraft (2) to study airload measurement techniques on large flexible aircraft and (3) to evaluate in flight a decoupler pylon system for preventing flutter of aircraft wings with external stores

W81-70042 **505-33-60**
National Aeronautics and Space Administration Washington D C
INTERDISCIPLINARY RESEARCH IN COMPOSITE STRUCTURES
Charles Bersch 202-755-2364

The objective is to conduct research in the application of advanced composite materials in the design and fabrication of aerospace structures The research will be performed by an educational institution utilizing interdisciplinary capabilities in materials engineering mechanical engineering aeronautical engineering civil engineering and chemistry Research projects will involve composite materials characterization structural

integrity structural analysis and design manufacturing techniques and system applications

W81-70043 **505-33-62**
Lewis Research Center Cleveland Ohio
INTEGRATED ANALYSIS AND SYNTHESIS
C C Chamis 216-433-4272
(505-33-22 505-33-52 505-33-72)

The general objective of this program is to develop accurate and affordable advanced computational methods computational facility architectures advanced and generic design concepts and the methodology and technology needed to support the structural synthesis of engine components and systems in an integrated multidisciplinary design environment Generic design concepts and the requisite methodology will be developed for the most promising applications of advanced materials and composites in engine systems The requisite methodology includes advances in all facets of integrated analysis/synthesis as well as the development of integrated modular computer programs (including software, firmware and hardware) streamlined for engine systems analysis/design/synthesis The program is balanced among in-house grant and contract efforts distributed as follows 40% in-house 20% grants and 40% contracts

W81-70044 **505-33-63**
Langley Research Center Hampton Va
AERONAUTICAL STRUCTURAL DESIGN METHODS
J Sobieski 804-827-3451
(533-01-13 510-54-13)

The objectives are to provide advanced analysis and synthesis capability for multidisciplinary evaluation and design of control configured structurally and aerodynamically advanced aerospace vehicles and to exploit advances in computer-aided design hardware and methodology The approach will be to develop integrated multidisciplinary analysis and synthesis methodology with emphasis on applications of advanced technologies including composite structures configuration aerodynamics and active controls and to define and demonstrate microprocessor and minicomputer hardware configurations to improve the efficiency for structural calculations

W81-70045 **505-33-72**
Lewis Research Center Cleveland Ohio
HIGH TEMPERATURE STRUCTURES
R H Johns 216-433-4380
(505-33-22)

The general objective of this program is to develop the technology necessary for the application of advanced materials and design concepts to aircraft turbine engine structures and to develop aerothermomechanical structural analysis and design methodology primarily for hot section components of advanced high-bypass commercial engines Included within the general objective is the development of analytical models and advanced computer graphic modeling techniques necessary for efficient and affordable stress-strain analysis as a function of time and temperature for complex components and load history conditions Emphasis will be on the development of structural design and analysis methods which will provide reliable lightweight engine structures having specified durability and life under the extreme environmental conditions experienced in the hot section of an advanced engine Engine system structural models will be developed to provide analytical capability to account for distortions and displacements due to transient and steady-state thermal and mechanical loads

W81-70046 **505-33-73**
Langley Research Center Hampton Va
HIGH TEMPERATURE AERONAUTICAL STRUCTURES
S C Dixon 804-827-3423
(506-53-33 506-53-63)

The objectives are to develop structural concepts for future hypersonic aircraft verify promising concepts by fabrication and tests of realistic structures and to devise analysis and design methods applicable to such concepts Research and development is being carried out to establish a technology base from which the structures and thermal control systems for hypersonic vehicles can be designed Included in the program are fabrication experimental and analytical efforts on both airframe and supersonic combustion ramjet (scramjet) structural concepts which will withstand the rigors of extended and repeated use in a hypersonic environment Research data obtained from both laboratory and wind tunnel experiments will serve to verify analysis and design methods, identify promising concepts and provide guidance for future research efforts The effort is focused primarily on convectively cooled concepts An actively-cooled panel program has been underway for several years Testing of three panel concepts and documentation of results should be complete by the end of FY-1981 Design studies of scramjet structural concepts have identified promising approaches and development and verification of fabrication techniques of various components constitute the major effort under this RTOP

Avionics and Controls Research and Technology

W81-70047 **505-34-11**
Ames Research Center Moffett Field Calif
NAVIGATION AND GUIDANCE SHORT-RANGE OPERATIONS
H Erzberger 415-965-5450
(532-01-11 532-02-11)

The objective is to conduct research on advanced guidance and navigation concepts for increasing the safety and efficiency of short-range aircraft operating in various air traffic control environments This objective will be approached in three tasks The first is to develop efficient on-board computer algorithms for generating and tracking minimum fuel 4D trajectories in a high density airspace A flight path management system incorporating such algorithms will be designed and evaluated in a simulated ATC environment The second task is to develop ATC flow management procedures and algorithms that exploit the potential of both advanced airborne guidance and ground computer capabilities to increase capacity and efficiency The integration of the airborne and ground procedures will be studied in a controller-pilot interactive ATC simulation The third task is to investigate several low cost navigation and state estimator concepts for closed loop guidance and control applications

W81-70048 **505-34-23**
Langley Research Center Hampton Va
COCKPIT AVIONICS GENERIC
J J Hatfield 804-827-3291
(534-04-13 504-41-63 505-34-43 505-34-13)

Development of advanced cockpit avionics technology (such as electronic display generators and media input/output techniques and systems integration techniques) coupled with advances in human factors research can greatly improve the flight deck of advanced jet transport aircraft cockpits of general aviation aircraft and crew stations of other types of aircraft This technology has the potential to reduce clutter and associated workload and to improve performance safety and flexibility while reducing avionics life-cycle cost Work done under this RTOP will develop cockpit requirements for future civil missions identify candidate concepts for future cockpit systems development technology for implementation of these concepts and perform proof-of-concept experiments using hot bench simulator and flight testing Technolog developments will be focused on electronic display media such as the CRT electroluminescent and liquid crystal panels on microprocessors display generation, multifunction switching and touch panel I/O techniques and on subsystem/system integration techniques Experimental testing will be performed in the early phases of the program on laboratory and engineering models Testing will then progress to prototypes and subsystems testing and culminate in the testing validation, and demonstration of an integrated cockpit system

W81-70049 **505-34-31**
Ames Research Center Moffett Field Calif
AIRCRAFT CONTROLS RELIABILITY ENHANCEMENT
C T Snyder 415-965-5567
(512-54-11 505-36-11 505-42-31)

Advanced control technology will be explored and developed to enhance the reliability of future aircraft flight control systems This will include in-house study activities and University grants oriented towards a unified methodology for the analysis and design of redundancy management and which will be implemented using digital techniques In-house activities will establish the potential of new concepts for redundancy identifiy the sensor/controller/software combinations pertinent to various regions of the flight envelope and determine the control logic for transition between control modes from normal operation to failure conditions University grants will be awarded to support promising research in the field and to keep NASA abreast of new advances in control theory pertinent to analysis and synthesis of redundant flight control systems

W81-70050 **505-34-32**
Lewis Research Center Cleveland Ohio
ELECTRONIC AIRCRAFT ENGINE CONTROL
D I Drain 216-433-6480

The objective is to develop a technology base for designing highly reliable digital electronic controllers needed for future aircraft turbine engine powerplants Present engines use hydromechanical controllers which exhibit extremely high reliability while operating in a severe environment on the side of the engine Electronic controllers needed for the control complexities of future engines must approach present reliability levels for acceptance into service The approach will be to employ the latest very-large-scale-integrated (VLSI) circuitry technologies in multiple processor fault tolerant architectures This approach will need not only hardware developments but also software technologies for accomplishing a fault tolerant controller The reliance upon a computer-based software control will require studies intended to develop techniques for insuring the integrity and reliability of needed high technology software

W81-70051 **505-34-33**
Langley Research Center Hampton Va
AIRCRAFT CONTROLS THEORY AND TECHNIQUES
J R Elliott 804-827-4681
(505-34-13 505-41-63)

The objective of this effort is to develop fundamental concepts design methods and application tools necessary for the safe and efficient operation of advanced aircraft to establish integrated design methods for advanced guidance and control systems to develop candidate integrated systems configurations with emphasis on active control aircraft and to validate system design procedures operation and performance The approach is to conduct studies leading to validation of procedures for mathematical modeling and analysis techniques of flexible aircraft with active controls to develop and demonstrate computer programs which will provide an optimized control system design to develop advanced guidance and control system techniques which are practical and consistent with available onboard aircraft instrumentation to develop aircraft parameter estimation algorithms with improved accuracy and computational efficiency to develop and validate advanced theoretical concepts for control of aircraft and their trajectories and to conduct research leading to a scientific/engineering data management system for use in computer-aided design studies of active control aircraft

W81-70052 **505-34-34**
Hugh L Dryden Flight Research Center Edwards Calif
AIRCRAFT CONTROLS FLIGHT SYSTEMS CONCEPTS
K J Szalai 805-258-3311
(512-54-14 505-34-31 505-34-33)

This RTOP aims to study develop and test cost effective methods of implementing advanced reliable flight control systems that will permit greater operational capabilities and increased performance of future aircraft without a reduction in safety and to conduct ground and flight tests of new concepts to verify design methods and validate performance predictions The emphasis will be on the application of microelectronics analytic redundancy management advanced control algorithms optical communication and distributed processing to highly reliable fly-by-wire control systems In addition analysis and modeling of lightning test data will be accomplished to provide design criteria and valid test methods to ensure immunity of advanced hydrid fly-by-wire control systems to electromagnetic hazards The F-8 Iron Bird and flight vehicle facility will be used to provide experimental data to validate theoretical results

W81-70053 **505-34-37**
Lyndon B Johnson Space Center Houston Tex
AIRCRAFT CONTROLS ELECTROMECHANICAL ACTUATOR TECHNOLOGY
J T Edge 713-483-2392
(505-34-34 505-34-43)

State-of-the-art magnetic materials and solid state switching components make feasible EM (electromechanical) actuators capable of performing the primary flight control actuation task(s) When applied to aerospace vehicles the results are the replacement of a large heavy difficult to maintain hydraulic system with a lightweight efficient and easily maintained EM actuation system The development objective is the extension and demonstration of the EM actuator technology developed at the Johnson Space Center to a representative aircraft application This extension will include the design and fabrication of a lab system for extended test and evaluation

W81-70054 **505-34-43**
Langley Research Center Hampton Va
INTEGRATION AND INTERFACING TECHNOLOGY
W Mace 804-827-3745
(505-34-31 505-34-34 505-44-13 512-54-11 512-54-14)

Aircraft of the 1990-2000 period can be more efficient and profitable as a result of technology advances already proposed by technologists The objective of this effort is to accelerate the acceptance of those advances by reducing the risk of the new technology New directions being taken by emerging safety and performance assessment methods for complex electronic systems offer expanded technical insight and will be the basis for the future validation process A methodology will be developed for integrating avionic and control functions modeling will continue for reliability safety and performance assessment candidate system architectural concepts will be identified and technology capable of contributing to improved system characteristics will be developed Lightning effects on digital avionics will be investigated and evaluation approaches developed

Human Factors Research and Technology

W81-70055 **505-35-13**
Langley Research Center Hampton Va
HUMAN RESPONSE TO NOISE
D G Stephens 804-827-3561
(505-33-53 505-32-03 505-41-43 505-35-13 532-06-13)

The objective of this research is to define and quantify stimulus environmental and human factors responsible for affecting community and passenger response to aircraft noise and operations Research studies will consist primarily of laboratory tests to subjectively evaluate the properties of aircraft-generated noise that are responsible for causing annoyance The laboratory program is aimed at developing criteria for evaluating the noise from single aircraft events as well as evaluating the response to longer term multiple aircraft exposures Subjects will experience the recorded noise of aircraft or the synthesized noise of future systems under simulated indoor outdoor and aircraft interior conditions Various psychophysical measures such as annoyance and speech interference will be used by the subjects to judge or rate the noise The resulting single event dose-response relationships will be directly applicable to the engineering assessment of source noise modifications and to aircraft certification procedures whereas the multievent results will be

applicable to the evaluation of aircraft/airport operations Field studies will be directed toward the development of a predictive model of community acceptance which includes in addition to the details of each noise level the frequency of events the time of day/night and the population distribution The model will be formulated such that it can be used to assess the noise abatement resulting from A/C modifications A/C operations and land use strategies

W81-70056 **505-35-21**
Ames Research Center Moffett Field Calif
FLIGHT MANAGEMENT SYSTEMS
H P Klein 415-965-5094
(505-35-31)

This program will investigate flight management and crew/system interaction mechanisms and requirements for current and advanced aircraft Specific objectives are to develop (1) procedures for the measurement and assessment of aircrew performance for current and future systems under varied conditions of automation ground authority traffic complexity and environmental conditions (2) guidelines for the design and use of automated systems in the cockpit (3) new technology for improved current and future man-system information interfaces such as navigation charts operating manuals warning and status annunciator systems pilot input systems head-up displays and panel displays and (4) new technology and methodology for aircrew training To accomplish these objectives manned full-mission and part-task simulations will be conducted to evaluate performance and workload measurement methodology and aircrew perception and decision-making functions in a variety of tasks and mission scenarios In-house studies in conjunction with contracts and university grants will be used to develop principles of optimal crew utilization and to evaluate training effectiveness Collaborative studies with the FAA industry and the military will be pursued to evaluate subsystems such as alerting and warning systems head-up displays cockpit display of traffic information and crew procedures

W81-70057 **505-35-23**
Langley Research Center Hampton Va
CREW INTERACTION WITH ADVANCED FLIGHT SYSTEMS
A A Spady 804-827-3871
(513-52-03)

This research activity will be directed toward the definition of crew responsibilities and interactions flight procedures and control and display requirements for the future civil air transportation system of the 1980-1990 s The approach is to develop the capability of quantifying visual information processes and apply this capability to understanding how a pilot functions and interacts with his flight environment This requires participation in the evaluation of current and future flight and ATC systems development of display and workload evaluation methods basic visual human factors research and the development of hardware and software for measuring and analyzing pilot s physiological functions These efforts are aimed at developing parameters that can be used as quantitative measuring tools for assessing and defining (1) crew performance (2) the content and format of displays and (3) flight procedures for the 1980-90 aircraft

W81-70058 **505-35-24**
Hugh L Dryden Flight Research Center Edwards Calif
HUMAN FACTORS FLIGHT RESEARCH WITH HIGH PERFORMANCE AIRCRAFT AND RPV'S
D T Berry 805-258-3311

This program utilizes RPV s (remotely piloted vehicles) and high performance aircraft particularly those with a single pilot to develop and evaluate the human factors aspects of highly integrated man/machine systems The pilot task load will be analyzed and correlated with the phychophysiological response of the pilot during the flights of manned and remotely piloted high performance aircraft These vehicles will have advanced capabilities such as high authority augmentation systems direct lift and sideforce and fuselage pointing While developing and utilizing RPRV and piloted aircraft flight test techniques cockpit configurations will be systematically varied while the effects upon pilot response are tabulated Both controls and display systems will be varied during the cockpit development This will include evaluation and optimization of remote visual systems

W81-70059 **505-35-31**
Ames Research Center Moffett Field Calif
SIMULATION TECHNOLOGY FOR AERONAUTICS
H P Klein 415-965-5094
(505-35-21 505-42-41)

The general objective of this research and development activity is to provide a scientific and technical base that can be used as a resource to develop valid reliable and economical simulators for aeronautical research development and crew training Specific objectives are (1) to develop human factors principles that can be used to evaluate and guide the effective utilization of flight simulators and automated training devices and (2) to develop advanced hardware and software concepts for high fidelity simulation of vision and motion environments The first of these two objectives will be met by continuing the study of human factors of reduced visibility scene technology initiating a study of peripheral cue requirements refining an analytical method for evaluating simulator motion performance based on a human sensory processing model and studying the potential for improving pilot training through the use of advanced simulation technology and compatible instructional strategies The second objective will be met by developing validation techniques for evaluation of simulators and simulation aircraft models developing techniques and concepts for simulation hardware such as computer graphics displays heads-up displays and motion systems and developing computational techniques that increase the effective speed of digital simulation computers

W81-70060 **505-35-33**
Langley Research Center Hampton Va
APPLICATION OF FLIGHT SIMULATION TECHNOLOGY
R L Bowles 804-827-3304

This RTOP s objective is the development and application of a technology base that will permit the economical and reliable substitution of simulators for actual flight operations in support of Langley s research programs It will cover both in-house and contractual studies which address current constraints in Langley simulator equipment in the formulation and validation of simulation math models and in the linkage of hardware/software systems to provide in the closed-loop pilot/simulator environment effective simulations Principal tasks for FY 1981 include (1) the initial correlation effort for man machine model predictions of tracking performance with in-simulator and Dryden flight data (2) a study to determine kinesthetic cue effectiveness for integrated control/display studies in the TCV simulator (3) site preparation and cab assembly of an advanced concept simulator and (4) the continuing extension and application of improved interactive performance assessment techniques Particular emphasis will be placed on mission simulation methodology, as a large scale terminal area simulation capability is being assembled locally for system studies needed to meet major objectives of the TCV program and the joint CDTI program Application of such a large complex multi-man system requires resolution of many detailed technical issues which will be addressed under this program Results of these efforts will be documented in NASA Technical Papers and Contractor Reports

Multidisciplinary Research

W81-70061 **505-36-11**
Ames Research Center Moffett Field Calif
FUNDS FOR INDEPENDENT RESEARCH (AERONAUTICS)
G T Chapman 415-965-5654
(505-56-11)

It is planned to support innovative and discretionary basic research in areas related to aeronautics The program pursues basic investigations of new technologies in fundamental science and engineering needed to satisfy NASA s requirements in aeronautics including the technical fields of aerodynamics fluid

mechanics flight mechanics power guidance and navigation applied mathematics propulsion and man-machine integration The OAST Research Council and the Ames Funds for Independent Research (FIR) Committee review unsolicited proposals that have been judged to be worthy of support on scientific or engineering grounds but have not been selected for support because of funding limitations in other research programs Those research proposals that are judged by the Council and FIR Committee to be worthy of support on a scientific or engineering basis are selected as candidates for funding

W81-70062 **505-36-12**
Lewis Research Center Cleveland Ohio
FUND FOR INDEPENDENT RESEARCH (AERONAUTICS)
Marvin E Goldstein 216-433-4000

The objective is to support innovative long range high risk basic research in areas related to aeronautics The program pursues basic investigations of new technologies in fundamental science and engineering needed to satisfy NASA s requirements in aeronautics including the technical fields of fluid mechanics materials noise pollution reduction combustion fuels and dynamic behavior and control Members of the Lewis Research Advisory Board at the request of the Chief Scientist review unsolicited research proposals that have been judged to be worthy on scientific or engineering grounds but have not been selected for support under the specific disciple programs because of the long range or high risk nature of the proposals or because of funding limitations in these other research programs Those research proposals that are judged by the Board to be worthy of support on a scientific or engineering basis are selected as candidates for funding These proposals are then prioritized by the Chief Scientist and funded to the extent permitted by available resources The Chairman of the OAST Research Council is kept informed of funding plans to prevent duplication and to provide coordination Progress and results are reported periodically by the Grant Monitor and submitted to the Chief Scientist for review and for distribution to OAST Research Council

W81-70063 **505-36-13**
Langley Research Center Hampton Va
FUND FOR INDEPENDENT RESEARCH (AERONAUTICS)
W D Erickson 804-827-2471

The objective of this plan is to support basic research in universities in areas related to aeronautics through the funding of a limited number of unsolicited research proposals from various universities University research proposals that have been judged to be well worth supporting on scientific or engineering grounds but have not been selected for support because of funding limitations in other research programs are considered University research proposals that have been evaluated and are not funded through any of the research programs are reviewed by the Langley University Research Proposal Review Committee Those research proposals that are judged by this committee to be well worth supporting on a scientific or engineering basis are selected as candidates for funding through this plan The committee establishes a priority listing of these proposals and selects those efforts that are judged to be the more innovative and aimed at the longer term research of potential relevance to future NASA aeronautics programs

W81-70064 **505-36-14**
Hugh L Dryden Flight Research Center Edwards Calif
FUNDS FOR INDEPENDENT RESEARCH
E E Kordes 805-258-3311

This RTOP is to support innovative and discretionary basic research in areas related to flight of aeronautical vehicles The program pursues basic investigation of new technology in fundamental science and engineering needed to improve the performance and efficiency of aeronautical vehicles including the fields of applied mathematics and computer science materials structures aerodynamics and fluid mechanics propulsion systems control systems and flight dynamics The Chief Scientist (OAST) and the Research Council review unsolicited research proposals that have been judged to be worthy of support on scientific or engineering grounds but have not been selected for support because of funding limitations in other programs Those research proposals that are judged by the council to be worthy of support are selected as candidates for funding

W81-70065 **505-36-20**
National Aeronautics and Space Administration Washington D C
CFD TRAINING PROGRAM
Ellis E Whiting 202-755-3280

The objective of the program is to produce highly trained people with advanced degrees in computational fluid dynamics (CFD) by developing a balanced graduate training program in CFD at a few selected universities A balanced program contains training in fluid physics aerodynamics computational methods and computer science

W81-70066 **505-36-21**
Ames Research Center Moffett Field Calif
AERONAUTICS GRADUATE RESEARCH PROGRAM - FY 1981
G Chapman 415-965-5654

The objective of this program is to develop the interest of student engineers in the field of aeronautical engineering provide on the job training in research methods and augment or enhance NASA s research programs The approach is to bring the Center s needs to the attention of the academic community Research topics are established by mutual agreement and the tasks are especially selected to not only be relevant to NASA s mission and of interest to the University faculty but to foster cooperative programs between the Government and Academia Cooperation may be evidenced by use of each others facilities and performance of the research at NASA installations The research conducted under this RTOP in FY 1981 will include aerodynamics acoustics flight mechanics and computational fluid dynamics It will be both theoretical and experimental in nature

W81-70067 **505-36-22**
Lewis Research Center Cleveland Ohio
GRADUATE RESEARCH PROGRAM IN AERONAUTICS
Marvin E Goldstein 216-433-4000

The objective of this RTOP is to sponsor graduate research and training in aeronautics which is relevant and acceptable to both NASA and the University Specific fields of research involve fluid mechanics engine inlet flow fans compressors fuels combustors mechanical components aeroacoustics materials engine dynamics and control computational fluid mechanics aeroelasticity and noise emissions

W81-70068 **505-36-23**
Langley Research Center Hampton Va
GRADUATE PROGRAM IN AERONAUTICS
W D Erickson 804-827-2471

This RTOP provides support for university graduate research in aeronautics in which there is a substantial involvement of graduate students at the Langley Research Center While formal classroom activities are conducted at a university campus a substantial portion of the graduate research activity is carried out at the Langley Research Center in conjunction with Langley staff and under the overall guidance of a faculty advisor The research pursued under this RTOP are in areas of aeronautics Research grants of cooperative agreements are awarded to a number of universities to pursue aeronautical research with support being mainly for graduate research students and to some extent faculty members associated with those students The selection of graduate research topics is determined by joint agreement between the university and NASA staff

W81-70069 **505-36-24**
Hugh L Dryden Flight Research Center Edwards Calif
UNIVERSITY RESEARCH IN FLIGHT TESTING TECHNIQUES
E E Kordes 805-258-3311

This RTOP supports university basic and applied research related to improving methods and techniques in flight testing of aeronautical vehicles The program is to promote the overall improvement in flight research through simultaneous advancement

in instrumentation testing methods equipment data recording and data analysis

General Aviation Research and Technology

W81-70070 **505-41-11**
Ames Research Center Moffett Field Calif
GENERAL AVIATION AERODYNAMIC PERFORMANCE TECHNOLOGY
R Hicks 415-965-6396
(505-31-31 505-31-41)

The objectives of this program are to provide an advanced technology base for the design of future aircraft that are safer more productive and clearly superior to foreign competition The approach is to use analytical prediction methods wind tunnel measurements and flight test to develop techniques for optimizing airfoils and wing designs and to develop techniques for reducing aerodynamic drag associated with wing-body interference

W81-70071 **505-41-13**
Langley Research Center Hampton Va
GENERAL AVIATION AERODYNAMICS AND HANDLING QUALITIES TECHNOLOGY
A W Hall 804-827-3274

An advanced technology base will be developed to permit the design of general aviation aircraft that are safer more productive and clearly superior to foreign competition This technology includes aerodynamic and propulsive performance stability and control and handling qualities The work will be accomplished by computer analysis and techniques simulator studies and wind tunnel and flight tests of models and full scale aircraft The work will involve tests and analysis for interference and design optimization drag reduction engine cooling drag improved airfoil design capability mission related stability control and handling qualities criteria improved stall/spin characteristics and improved flight test methods for measuring aircraft performance

W81-70072 **505-41-18**
Wallops Flight Center Wallops Island Va
GENERAL AVIATION AIRCRAFT AERODYNAMICS AND FLIGHT DYNAMICS
W E Melson 804-824-3411

The objective of this RTOP is to provide an advanced technology base for the design and operations of future general aviation aircraft that are safer and fuel efficient by pursuing analytical experimental and systems studies of general aviation piloting techniques air traffic control procedural concepts and aircraft flight dynamics Specific research areas ultra-deep-stall descent VFR pilot performance in the terminal area heavy rain effects on aircraft performance and safety noise exposure simulation model and air traffic multi-glide slopes Various data collection techniques are utilized to obtain data on aircraft flight dynamics and piloting procedures in the operating environment These include single and multiple radar tracks in various environments pilot questionnaires photographic data and other techniques Data are analyzed integrated into simulation models and simulations conducted to assess various design or operating alternatives

W81-70073 **505-41-22**
Lewis Research Center Cleveland Ohio
ADVANCED GENERAL AVIATION PROPULSION RESEARCH
E A Willis 216-433-6909

The objectives are to define the technology base for and promote the development of improved conventional spark ignition and the most promising alternative engine(s) for general aviation use in the late 1980s and on The specific improvements and/or capabilities sought are multi-fuel lower BSFC weight cost and maintenance and improved reliability - while still meeting the 1979 emission requirements Alternative engines are being defined through studies and experimental engine tests supplemented by experimental investigations in key technology areas The specific work in this program is supported by contracts grants and Lewis in-house studies and experimental programs

W81-70074 **505-41-33**
Langley Research Center Hampton Va
GENERAL AVIATION CRASH DYNAMICS
R G Thomson 804-827-3795
(505-33-53)

Both analytical and experimental methods will be used to develop and demonstrate new concepts in general aviation aircraft fuselage and interior design for improved vehicle crashworthiness In-house full-scale and component testing of aircraft structures will be performed to determine the basic mechanisms involved in crash behavior and energy dissipation phenomena and will provide a means of defining pertinent crashworthiness parameters In conjunction with the testing computer programs are being developed to simulate the gross fuselage behavior during crash impact and the dynamic response of localized structural components and seat and occupant behavior Complimentary in-house and contractual studies will be employed to establish the best analytical modeling techniques for predicting accelerations loads and displacements of collapsing structure The developed computer programs will be coupled with research on load limiting seat and subfloor concepts to design modified structural components with improved crashworthy characteristics The new concepts will be demonstrated and evaluated by full-scale and component testing

W81-70075 **505-41-43**
Langley Research Center Hampton Va
GENERAL AVIATION PROPELLER NOISE REDUCTION
J P Raney 804-827-2645
(535-03-13 505-42-13 532-06-13)

The objective of this research is to provide data and a technology base for reducing general aviation propeller noise with minimum weight performance and economic penalties Both analytical and experimental studies are involved and work will be accomplished both inhouse and by grants and contracts The emphasis of the analytical effort is on the prediction of both propeller noise and the aerodynamic parameters which determine propeller noise The emphasis of the experimental program is on evaluating noise prediction/reduction technology through model-scale tests with flight evaluation and demonstration of technology as required Noise prediction is used both as a tool for developing noise reduction technology and to identify technology areas requiring further research

W81-70076 **505-41-52**
Lewis Research Center Cleveland Ohio
LOW-SPEED PROPELLER RESEARCH
D C Mikkelson 216-433-6820

The objective of this program is to advance the technology of propellers for General Aviation aircraft to reduce energy consumption lower noise and improve aircraft safety This program encompasses analytical and experimental work on propeller performance acoustics aeroelastic characteristics and low cost composites Technology under this program will encompass a broad spectrum of propeller sizes power requirements and aircraft speeds applicable to current and future general aviation aircraft

W81-70077 **505-41-63**
Langley Research Center Hampton Va
GENERAL AVIATION AVIONICS AND CONTROL TECHNOLOGY
D R Downing 804-827-3209
(505-41-73 505-34-33 505-34-13)

The objective of this work is the development of advanced control display communication navigation guidance sensing and actuating concepts that will enhance the safety and utility of general aviation aircraft The approach is to develop advanced avionics concepts and to evaluate their utility through simulation and flight studies Both new concepts and those developed for CTOL and VTOL applications will be considered Examples of research areas include (1) the use of advanced navigation control

and display systems to improve path tracking and reduce pilot workload during IFR terminal area operations (2) the use of data link systems to assist the pilot perform on-route and terminal area guidance and (3) the development of sensor and actuator concepts which provide new measurements or which replace expensive low reliable components Improved performance and increased capabilities without increased avionics cost are program goals

W81-70078 **505-41-68**
Wallops Flight Center Wallops Island Va
GENERAL AVIATION AVIONICS AND CONTROLS
W E Melson 804-824-3411

The aim of this RTOP is to develop and demonstrate advanced avionics and control systems feasibility of utilizing low cost digital systems technology for general aviation aircraft to improve performance safety operational capability and compatibility with air traffic control systems Specific research areas include automated pilot advisory system concept synthetic voice technology digital crash recorder feasibility assessment and digital in-flight IFR simulator development Studies of systems concepts systems definition engineering model development evaluation and demonstration of technology improvements will be used to achieve the technical goals

W81-70079 **505-41-73**
Langley Research Center Hampton Va
GENERAL AVIATION - SINGLE PILOT IFR SYSTEMS
J D Shaughnessy 804-827-3917
(505-41-63)

This effort will provide the background research and develop the technology required to improve the safety and utility of single pilot general aviation (GA) aircraft operating under instrument flight rules (IFR) Functional roles and requirements of the IFR pilot will be determined for current as well as future air traffic systems The pilot environment psychological state workload required actions and the interrelationship between these factors will be defined and characterized so pilot effectiveness can be maximized Aircraft and subsystem requirements will be assessed and design data and guidelines will be developed for systems that significantly aid the single pilot flying under IFR It will be determined if selected modifications to ATC procedures aids and pilot training might improve safety and utility of single pilot IFR operations Analyses simulation studies and flight tests will be performed on various cockpit display formats automatic and manual control systems advanced avionics systems flight data consoles microprocessor applications multi-mode displays flying qualities procedural and other software concepts speech synthesis and recognition capability advanced ATC concepts and advanced information and flight management systems

W81-70080 **505-41-83**
Langley Research Center Hampton Va
AERIAL APPLICATIONS AERODYNAMICS AND SYSTEMS INTERACTION
A W Hall 804-827-3274

The objective of aerial applications research is to improve the effectiveness and efficiency of agricultural production systems through application of aeronautical technology Specifically the technology will be developed for both short- and long-term improvements in the accuracy of distribution environmental health and safety aspects of aerial applications and improvements in aircraft aerodynamics flight controls structures and dispersal systems

Low-Speed Aircraft Research and Technology

W81-70081 **505-42-11**
Ames Research Center Moffett Field Calif
ROTORCRAFT AEROELASTICITY AND STRUCTURAL DYNAMICS
W Johnson 415-965-5043
(505-42-21)

The objective of this research is to improve the predictive capability for rotorcraft loads vibration aeroelastic stability and performance and where possible to develop rotors with improved dynamic characteristics This will be accomplished by developing and verifying analytical models for rotorcraft with particular emphasis on the structural dynamics and aeroelasticity It is important to note that the level of predictive capability required depends on the type of aircraft considered as well as on the technology level For some simple well-understood rotor systems satisfactory predictive capability may have already been achieved for new rotor systems and rotorcraft configurations additional work will always be required The accuracy of current and improved models of rotor dynamics will be assessed by comparison with experimental data As appropriate small scale and large scale wind tunnel tests will be conducted in order to define dynamics problems and verify and improve advanced analytical models

W81-70082 **505-42-13**
Langley Research Center Hampton Va
ROTORCRAFT STRUCTURES, VIBRATION, AEROELASTICITY, AND ACOUSTICS
W H Reed III 804-827-2265
(532-06-13)

The technology for the application of composite materials and design concepts in helicopter structures to improve performance and efficiency reduce costs and provide durability and energy absorption capability equivalent of metal structures will be developed through in-house and contractual studies Long-term durability of Kevlar secondary structures and graphite primary structures will be determined through flight service and structural testing studies Through analysis wind tunnel and flight studies effective means for reducing helicopter vibrations and evaluating aeroelastic characteristics of new rotor systems will be determined Active higher harmonic control of vibrations will be developed in wind tunnel studies and demonstrated in flight Analytical techniques for predicting coupled rotor/fuselage vibration levels will be developed and the application of structural optimization techniques to rotor blade design for minimizing vibrations will be evaluated Improved predictive methods for analysis of the unsteady airloads on rotors will be developed through in-house and contract studies Analytical and experimental studies will be made to identify significant factors contributing to the aerodynamic acoustic and aeroelastic characteristics of rotors Methods for predicting and reducing helicopter main and tail rotor noise will be developed and evaluated

W81-70083 **505-42-21**
Ames Research Center Moffett Field Calif
ROTORCRAFT AERODYNAMIC PERFORMANCE, DYNAMICS, AND HANDLING QUALITIES
W Johnson 415-965-5043
(532-03-11)

This RTOP covers research on all aspects of rotor aeromechanics (aerodynamics dynamic loads and stability performance and noise characteristics) and rotorcraft flight dynamics Flight dynamics research will be conducted to provide handling qualities and design criteria for specific missions The research will be conducted through analysis including math model improvement and development of advanced techniques of control system implementation ground based piloted simulation and flight research with the UH-1H (with V/STOLAND) and CH-47 The understanding and predictive capability of the aerodynamic and dynamic phenomena of advanced rotorcraft will be improved by conducting analytical small scale and full scale experimental

investigations of helicopter performance and noise rotor aerodynamics and wake characteristics drag and aerodynamic interference and rotor loads vibration and vibration reduction systems Specific advanced rotor configurations will be tested in the full-scale wind tunnel Theoretical and experimental research will be conducted to develop techniques to design rotors optimized for aerodynamic performance These techniques will include the effects of platform geometry airfoil section dynamic stall and wake-induced inflow Analytical models for the flow about rotorcraft fuselages including wake interaction will be developed

W81-70084 **505-42-23**
Langley Research Center Hampton Va
ROTORCRAFT AERODYNAMICS SCALE MODELING
J C Wilson 804-827-3611
(505-42-13)

The objective is to acquire experimental data both aerodynamic and acoustic regarding helicopter systems and components for correlation with analyses Using modeled helicopter systems and the Langley V/STOL wind tunnel experimental investigations will be conducted to acquire rotor performance data for advanced rotor configurations to measure rotor noise characteristics in particular blade slap for designed alleviation and to measure rotor wakes and wake effects for correlation with evolving computer codes

W81-70085 **505-42-31**
Ames Research Center Moffett Field Calif
INTEGRATED AVIONIC CONTROL SYSTEMS FOR ROTORCRAFT
G Meyer 415-965-5444
(505-34-31 512-54-11 505-42-21)

Advanced control technology will be developed to provide effective integration of airframe propulsion and subsystem control functions to enhance the performance economic viability and safety of future rotorcraft Studies of a total automatic flight control system (TAFCOS) which uses a combination of open loop and closed loop controls will continue using the UH-1H helicopter In addition the TAFCOS concept will be extended by applying it to the design of a flight control system for the tilt rotor aircraft and evaluating the performance of the resulting system A methodology for the system design and analysis will be developed This methodology will include the development of software and a distributed fault-tolerant network of microprocessors The necessary information/display concepts for adequate redundancy management will also be defined and developed Advanced concepts of redundant actuator systems will be studied and suitable redundancy management techniques developed with specific attention to system performance failure effects reliability and maintainability Advanced concepts of fault-tolerant data communication will be studied and a means for integrating the sensing computation display and actual elements will be developed The resulting total fault-tolerant system will be evaluated in terms of safety cost reliability and maintainability using principally manned simulation and when necessary flight tests

W81-70086 **505-42-51**
Ames Research Center Moffett Field Calif
HEAVY-LIFT/SHORT-HAUL HYBRID AIRSHIP TECHNOLOGY
W H Deckert 415-965-6373
(530-02-11)

The objective of this RTOP is to provide aerodynamics flight dynamics control systems and structural dynamics technology development for promising modern hybrid airship concepts Emphasis will be on the flight dynamics simulation of a hybrid airship concept called the buoyant quad-rotor employing substantial amounts of rotor forces for lift and control and designed for transporting heavy payloads over short ranges In addition to the buoyant quad-rotor concept other heavy-lift/short-haul hybrid airship concepts will be studied including those with turbo-prop and ducted-fan propulsive-lift systems possibly in combination with rotor systems The program is currently concentrating on areas known to have the greatest uncertainties modeling and control of interconnected rotors aerodynamic interactions of rotors and envelopes and gust and turbulence modeling Follow-on efforts will concentrate on effects of structural flexibility and control law development The work to be done includes analytical studies, computer simulation and wind tunnel testing

W81-70087 **505-42-62**
Lewis Research Center Cleveland Ohio
V/STOL PROPULSION RESEARCH
Carl C Ciepluch 216-433-6644
(532-05-12 532-05-11)

An efficient lightweight reliable lift/cruise propulsion system is a critical requirement for the successful design of V/STOL aircraft The technology base to provide the required system will be developed in selected critical areas which are unique to the V/STOL concept Analytical and experimental investigations will be conducted in the areas of fans inlets thrust deflector nozzles thrust control devices and ejectors operating in the hover and transition modes for both subsonic and supersonic propulsion system concepts

W81-70088 **505-42-71**
Ames Research Center Moffett Field Calif
ADVANCED V/STOL AIRCRAFT AERODYNAMICS AND FLIGHT DYNAMICS RESEARCH
A Faye 415-965-6373
(505-31-41 532-05-11 530-02-11)

The objective of this RTOP which is a companion to RTOP 532-05-11 is to develop basic research and technology required to enable the development of military and civil aircraft having V/STOL capability and viable mission performance Theoretical and experimental generic research will be undertaken in the areas of high speed aerodynamics low speed aerodynamics and flight dynamics To insure that all major high speed propulsion system/airframe interactions are accounted for properly compact propulsion simulator technology will be developed for use in scale wind tunnel models of V/STOL configurations Methods for predicting high speed aerodynamic performance and forebody/inlet interactions will be refined Low speed wind tunnel aerodynamic research will concentrate on development of aerodynamic prediction techniques for both transition and ground effects improvement of experimental techniques and evaluation of methods for efficient control of V/STOL aircraft in hover Flight control system and display requirements will be investigated concurrently primarily through piloted simulation The flight control and display requirements obtained from simulation will be verified for all V/STOL flight phases when a suitable research aircraft becomes available

W81-70089 **505-42-74**
Hugh L Dryden Flight Research Center Edwards Calif
AV-8A V/STOL FLIGHT EXPERIMENTS
D H Gatlin 805-258-3311
(505-42-71 532-05-11)

The AV-8A program is directed at obtaining high quality aerodynamic performance and system models of the aircraft and also at improving flight test techniques for high diskloading V/STOL aircraft The results will be used to update simulating models for V/STOL flight dynamics research and to improve flight test and parameter identification techniques suitable for V/STOL-unique flight regimes First parameter identification and V/STOL modeling techniques will be studied to establish maneuvers and mathematical methods to be used during the flight test program An AV-8A or AV-8C model aircraft will then be instrumented and flown at Dryden A complete flying qualities investigation will accompany the parameter estimation tests so that existing handling qualities criteria and design guides may be validated as well

High-Speed Aircraft Research and Technology

W81-70090 **505-43-11**
Ames Research Center Moffett Field Calif
FLIGHT VEHICLE DYNAMICS
G N Malcolm 415-965-6266
(505-31-41)

The objective of this research is to provide a basic understanding of the aerodynamic and flight dynamic characteristics of highly maneuverable aircraft through the development and utilization of improved wind tunnel measurement and analytic techniques including both static and dynamic methods Ultimately through application of improved methods of testing and application of the test results including better simulations resulting from improved aerodynamic mathematical models new criteria can be established for designing vehicles capable of performing controlled maneuvers over an expanded angle of attack envelope Investigations are in progress to evaluate various experimental methods for determining dynamic characteristics of aircraft and experimental capabilities are being upgraded for testing at high angles of attack and high Reynolds numbers both for static and dynamic characteristics Dynamic apparatus are being investigated or constructed to evaluate aerodynamic coefficients which are pertinent to all phases of high maneuver flight from controlled motions to fully developed spins Basic investigations are in progress to provide fundamental understanding of fuselage aerodynamics at high angles of attack

W81-70091 **505-43-13**
Langley Research Center Hampton Va
FLIGHT DYNAMICS
J R Chambers 804-827-2184

The broad objective is to improve the stall/spin characteristics of high performance aircraft and to determine the effects of these characteristics in terms of piloting the aircraft Specific objectives are (1) to investigate the fundamental nature of stall/spin including the development of test techniques and methods for theoretical analysis (2) to develop and evaluate the effectiveness of automatic spin prevention concepts (3) to determine static and dynamic aerodynamic characteristics of current and advanced configurations at high angles of attack and (4) to determine geometric characteristics which result in inherent spin resistance The methods of approach include static and dynamic wind tunnel force tests theoretical analysis piloted simulator tests and dynamic model flight tests Extensive participation in DOD airplane development programs is involved

W81-70092 **505-43-14**
Hugh L Dryden Flight Research Center Edwards Calif
FLIGHT DYNAMICS AND HANDLING QUALITIES
D T Berry 805-258-3311

The overall objective of this effort is to develop a better understanding of the phenomena improved analytical and experimental techniques and new concepts related to dynamic and handling quality characteristics of aircraft in all flight regimes Studies will be conducted to develop analytical techniques for determining stability and control derivatives from flight data to develop new techniques for evaluating handling qualities and for achieving desired aircraft responses and to develop improved aeroelastic aircraft analysis techniques Analytical studies computer algorithm development and programming and flight tests will be performed both inhouse and under contract and grants to meet these objectives Improved techniques for estimating the unknown parameters of the math model and for improving the identifiability of the systems will be studied on flight test data The stochastic control based on the estimates will then be tested in flight to assess the improvement of the system Also the range of command responses of augmented vehicles that optimizes pilot-vehicle performance for a specific mission or task within a mission will be investigated Emphasis will be on criteria for command responses that are meaningful to system designers

W81-70093 **505-43-21**
Ames Research Center Moffett Field Calif
HIGH PERFORMANCE AIRCRAFT AIRFRAME-PROPULSION INTEGRATION
T J Gregory 415-965-5881
(505-42-71 532-05-11)

The objective of this RTOP is to investigate airframe/propulsion system integration for advanced combat aircraft Conceptual designs of such aircraft have incorporated a number of new features that potentially impact the integration of the airframe and propulsion system Among these include the use of top mounted inlets with canards and strakes in close proximity to and in front of inlet system One of the available VSTOL fighter configurations presently scheduled for wind tunnel testing will be modified to investigate the canard/strake/inlet interactions in more detail This effort will be expanded to look at the influence of various forebody shapes on the inlet flow field and performance In addition the model will be modified incorporating an ejector system into the flow metering section to provide inlet pumping to ensure accurate simulation at high angles-of-attack Another area of concern that has arisen in developing some advanced configurations with the exhaust nozzles located near the center of gravity for either vertical or short take-off and landing operations is the effects of the exhaust plumes on the wave drag of the configuration A research program with industry will be initiated to investigate these effects and correlate the results with available prediction methods

W81-70094 **505-43-22**
Lewis Research Center Cleveland Ohio
COMBAT VEHICLE AND MISSILE AERODYNAMICS AND FLIGHT DYNAMICS RESEARCH AND TECHNOLOGY
David N Bowditch 216-433-6123
(505-04-12)

The objective of this RTOP is to establish through analytical studies system design efforts model and full-scale test programs the technology base required for the application of unique configurations to future combat aircraft The Lewis effort is focussed on propulsion system installation Current activities are specifically directed toward providing the technology required for the design of nonaxisymmetric exhaust nozzles for turbine engines The high maneuverability and STOL requirements anticipated in future aircraft designs lead to the application of nonaxisymmetric nozzles capable of thrust vectoring and reversing Principle areas of concern will include cooling heat transfer structural design weight and internal aerodynamics The objectives will be accomplished through contract studies nozzle design fabrication and altitude testing Particular emphasis will be placed on solutions to the complex cooling structural and internal aerodynamic problems associated with nonaxisymmetric nozzles Close coordination will be maintained with Langley Research Center the Navy and the Air Force to assure that work in the propulsion area appropriately supports Air Force requirements and the aerodynamic work at Langley

W81-70095 **505-43-23**
Langley Research Center Hampton Va
COMBAT VEHICLE AND MISSILE AERODYNAMICS AND FLIGHT DYNAMICS
C M Jackson 804-827-3134

The technical objective of this work is to develop the aerodynamic technology base for the design of future military aircraft and missile concepts Analytical and experimental studies will be made to develop aircraft design rationale and evaluate advanced aerodynamic concepts such as supercritical aerodynamics wing warp maneuver devices thrust-induced lift nonaxisymmetric nozzles and component interference Similar studies will be made to extend the aerodynamic technology base for missile system including conventional cruciform stability and control concepts airbreathing propulsion integration and monoplanar concepts Studies will also be made to provide a technology base for evaluation of missile carriage and separation aerodynamics

W81-70096 **505-43-31**
Ames Research Center Moffett Field Calif
INTERAGENCY AND INDUSTRIAL ASSISTANCE AND TESTING
F W Steinle 415-965-5850

Technical assistance consultative services, and support through the use of NASA facilities will be provided to outside agencies and the aircraft industry Principal assistance is to the Department of Defense (DOD) for aircraft and missile systems development programs Joint activities will be conducted with other government agencies and industry Industry support is generally provided on a fee basis Areas of support include research activities to aid in assuring satisfactory aerodynamic and handling qualities of piloted aircraft in routine operational flight and in advanced weapon delivery tasks and in assuring satisfactory flight path and attitude control of these aircraft in given automatic flight modes (i e radar-guided approaches and landings on an aircraft carrier) Included are efforts to define and develop techniques for improvements of marginal or unsatisfactory characteristics of new airplane designs Wind tunnels flight simulators and central computer facilities (360 7600) together with applications of advanced control theory will be employed as required FY-81 support is planned for the following specific systems AV-8 F-18 Advanced Fighter Technology Integration Program (AFTI) Submersible Bodies Douglas ATMR Douglas AST Boeing 767 Boeing C-14 Advanced Missiles Damaged Missiles Advanced Aircraft and Grumman/Navy VTOL Aircraft

W81-70097 **505-43-33**
Langley Research Center Hampton Va
INTERAGENCY AND INDUSTRIAL ASSISTANCE AND TESTING
D V Maddalon 804-827-3838

The broad objective is to provide technical assistance and consultative services to outside agencies and aircraft industry programs which involve specific requests for NASA support The principal assistance is to the Department of Defense for aircraft and missile development programs Current activity is focused in the areas of stall/spin aerodynamic characteristics at subsonic transonic and supersonic speeds flutter and aeroelasticity structures landing loads simulation and propulsion system interactions on airframes and nozzles The approach will involve tests in applicable Langley facilities consistent with the availability of test time and the utilization need for the particular facilities requested Analysis of test results will be performed and selected results will be documented Consultation will include participation in pretest conferences technical evaluation boards and technical coordination and oversight committees

W81-70098 **505-43-34**
Hugh L Dryden Flight Research Center Edwards Calif
INTERAGENCY ASSISTANCE AND TESTING
R G Bryant 805-258-3311

This RTOP is intended to cover interagency assistance using applicable Dryden flight test facilities The broad objective is to provide technical assistance consultative services and test facility support to DOD for military programs and to industry which involve specific requests for NASA support Recent activities of this kind include B-52 drop test for recertification of the F-111 crew escape system component improvement tests involving F-15 T-37 F-111 aircraft and support of the AFTI-16 (F-16) program Some current activities include support of the Navy F-18 program and Firebrand Research Test Vehicle program Analysis of test results will be performed and selected results will be documented Consultation will include participation in pre-test conference technical evaluation boards and technical coordination committees

W81-70099 **505-43-44**
Hugh L Dryden Flight Research Center Edwards Calif
REMOTELY PILOTED RESEARCH AIRCRAFT TECHNOLOGY
W H Andrews 805-259-3311

This RTOP covers two areas the RPRV Facility Development Program and the AD-1 Oblique Wing Research Airplane The facility development task deals with the continued improvement of the Remotely Piloted Research Vehicle Facility to support the flight testing of high performance and high risk vehicle concepts of the future The facility development involves an on-going assessment of the software and hardware avionics interfaces between the respective test vehicles and the facility and equipment updating to meet additional and new requirements The manned low speed jet Oblique Wing Airplane flight testing was initiated in December 1979 and to date twelve flights have been performed During these flights the operational envelope has been expanded to an airspeed of 170 knots and a sweep angle of fifteen degrees Due to uncertainties related to wing structural behavior at the higher sweep angles flight envelope expansion is being accomplished for sweep angle changes of five degrees To date the flying qualities appear as predicted with slight changes showing up in the comparison of the flight versus windtunnel predicted aerodynamic derivatives

W81-70100 **505-43-54**
Hugh L Dryden Flight Research Center, Edwards Calif
AIRCRAFT OPERATIONAL SUPPORT
B D Axley 805-258-3311

Equipment maintenance and operation are provided for (A) support aircraft including (2) F-104N (3) F-104G (1) T-38 (1) T-37 (1) C-47 and (B) Bell Helicopter and (B) service aircraft including B-52 PA-30 and JetStar Major effort and coordination of activities is provided by inhouse resources with augmentation by supporting contractors (engine maintenance AGE maintenance inventory management) and reimbursable military elements (fuel parts special functions) This effort supports research flight programs providing adequate proficiency of pilots chase aircraft R/D support in terms of research investigations and general operational support

Transport Aircraft Research and Technology

W81-70101 **505-44-12**
Lewis Research Center Cleveland Ohio
AVIATION METEOROLOGY RESEARCH
R W Luidens 216-433-4000

The objective of this program is to update and advance the technology related to the safe and efficient operation of aircraft under atmospheric icing conditions The program will be broad based encompassing both analytical and experimental research and conducted using in-house contracted and university effort It will be performed as a coordinated effort between the aircraft industry/users Government agencies and the military NASA will serve as the focal point for assembling a wide range of data and for dissemination of the data

W81-70102 **505-44-13**
Langley Research Center Hampton Va
AVIATION METEOROLOGY RESEARCH-SEVERE STORMS RMS
A W Hall 804-827-3274
(505-44-23)

A technology base will be developed to improve the knowledge and understanding of atmospheric processes as they effect the design and safe and efficient operation of aircraft and aircraft systems This will be accomplished by experimental and analytical programs aimed at providing an understanding of the predictability and the detectability and avoidance of hazards of severe storms to aircraft operations These hazards include wind shear turbulence lightning precipitation and icing Protection against direct lightning strikes will be studied

W81-70103 **505-44-14**
Hugh L Dryden Flight Research Center Edwards Calif
KNOWLEDGE OF HIGH ALTITUDE ATMOSPHERIC PROCESSES
T R Sisk 805-258-3311

The objective of this work is to improve the definition of atmospheric characteristics required for advanced aircraft design

and for more efficient safe aircraft operation Phenomena which are emphasized include clear air turbulence wind shear temperature transients pressure altimetry problems and aircraft icing Data on these phenomena are obtained from instrumented aircraft and are related to the meteorological conditions causing them by the use of mathematical models and climatological information This work covers the study efforts both in-house and on contracts or grants as well as the development and acquisition of sensors needed to measure the atmospheric phenomena Results of this work are applicable to aircraft system design flight test activities and flight operations

W81-70104 **505-44-15**
Jet Propulsion Laboratory Pasadena Calif
MICROWAVE TECHNOLOGY DEVELOPMENT FOR ATMOSPHERIC TURBULENCE STUDIES
B L Gary 213-354-3198

This RTOP is an outgrowth of the 1979 Clear Air Turbulence Flight Test Program During these flights involving three experimenters JPL demonstrated that passive microwave radiometers can measure altitude temperature profile for the altitude vicinity of the aircraft It was further demonstrated that CAT (Clear Air Turbulence) is often associated with inversion layers During FY-80 an improved microwave radiometer is being built for installation in NASA s C-141 (Kuiper Airborne Observatory) The objectives of this RTOP are to (1) obtain many flight hours of data with the new radiometer and begin to systematically explore the altitude relationship between CAT and inversion layers and (2) to investigate the possibility of using inversion layer lapse rate and inversion layer thickness for the prediction of maximum turbulence intensity The approach is to employ statistical concepts to the relationships between the flight hours with turbulence at various severity levels the flight hours during which turbulence was and was not associated with flight within and close to inversion layers (and tropopause) Turbulence severity will be determined by measurements of the peak-to-peak excursion of the aircraft s vertical accelerometer during 5-second windows (with roll-related excursions not included)

W81-70105 **505-44-18**
Wallops Flight Center Wallops Island Va
AVIATION METEOROLOGY RESEARCH ATMOSPHERIC DYNAMICS AND MEASUREMENT TECHNOLOGY
Robert E Carr 804-824-3411
(505-08-28)

The objectives of this RTOP are to collect analyze and model severe low-altitude wind shear turbulence and storm outflow dynamics data as they apply to the safe and efficient operations of aircraft and aircraft systems and to identify and test advanced sensors for automatic measurement of prevailing visibility ceiling heights and wind shear The comprehensive meteorological measuring systems existing at Wallops Flight Center (WFC) will be utilized to collect data associated with significant meteorological phenomena related to aircraft operating safety Systems applicable to this research include two meteorological towers (250 ft and 300 ft) instrumented with two and three dimensional anemometers and other sensors precision wind profile balloons and radiosondes precision video and doppler radars LDAR a fully equipped observation service and equipments and instrumented test aircraft Experiments will be configured to provide intense coordinated measurements during severe and/or significant meteorological events Emphasis will be placed on low-altitude spatial changes as related to the specific aircraft operating problem during approach and departure flight phases and in identification of advanced meteorological sensor characteristics to meet current operational needs

W81-70106 **505-44-19**
Marshall Space Flight Center Huntsville Ala
AVIATION METEOROLOGY RESEARCH - BASIC ATMOSPHERIC PROCESSES
Dennis W Camp 205-453-2087

Objectives are (1) to define investigate and model those atmospheric conditions adverse to aircraft operations and possibly conductive to aircraft mishaps and (2) to conduct research relative to development of technqiues, procedures and the need for new and/or improved meteorological instrumentation whereby acquired knowledge of the natural environment can be better utilized for the safe operation of aeronautical systems The approach will be to continue (1) to measure and analyze atmospheric data (2) to develop models of atmospheric boundary layer properties and the conditions which lead to or intensify them (3) to perform analytical laboratory and field tests relative to investigation of warm fog and (4) to develop and/or modify instrumentation as needed to meet the requirements of this approach To accomplish the objectives the following tasks will be performed (1) correlation of lateral and longitudinal gusts and their effects on aeronautical systems and conduct of an aviation meteorology workshop (2) atmospheric dynamics process definition as related to aeronautical system operations (3) warm fog investigative studies relative to its dispersal (4) investigation into buildup and dissipation of frost effects on aeronautical systems (5) development of new or improved instrumentation for safer operation of aeronautical systems and (6) atmospheric electricity as related to aeronautical systems

W81-70107 **505-44-21**
Ames Research Center Moffett Field Calif
AVIATION SAFETY TECHNOLOGY - OPERATIONAL PROBLEMS AND FIREWORTHINESS
R L Kurkowski 415-965-6219
(505-33-31 534-05-11)

The objective of this RTOP is to improve aviation safety by increasing the understanding of the causes of accidents and by developing systems technology and piloting techniques for avoiding hazards Research on post-accident analysis techniques is a cooperative program with the National Transportation Safety Board Bureau of Aviation Safety (NTSB-BAS) The objective is to develop improved techniques for analyzing accident recordings Additionally as part of a joint NASA/FAA program simulator investigations will be conducted on the effectiveness of integrated head-up displays (HUD) on reducing hazards associated with wind shear and low visibility Research will also be conducted in new technology to enhance the operational safety of IFR operations for civil and military rotorcraft and VTOL aircraft The program on fireworthiness is oriented towards enhancing aircraft cabin safety in post-crash fires The program includes (1) fuel anti-misting studies and the determination of fluid properties of modified jet fuel for inhibiting the ignition of fuel (2) definition of post-crash fire threat scenarios (3) development of laboratory flammability test methodology and combustion toxicology methods (4) development of a cost beneficial survivability model for aircraft fire safety (5) the evaluation of advanced aircraft interior materials which are fire-safe and provide advantages such as weight savings and (6) evlauation of fire extinguishers

W81-70108 **505-44-22**
Lewis Research Center Cleveland Ohio
AVIATION OPERATIONS SAFETY TECHNOLOGY
R Luidens 216-433-4376

The objective of this RTOP is to provide a broad base of safety oriented technology for identifying defining and dealing with hazards associated with aeronautical propulsion systems and aircraft operation and establish criteria for systems design and operating techniques leading to reduction in accidents loss of life and injuries and loss of equipment Research and technology activities that lead to solutions of problems impacting on aviation safety with particular emphasis on propulsion systems will be performed Activity results will be coordinated with the FAA NTSB DOD other interested Government agencies and the aviation community Specific areas of current activities include hazards evaluation and safety assurance of liquid hydrogen and other fuels for use in aircraft fuel systems crash fire prevention engine condition monitoring and systems safety analyses

W81-70109 **505-44-23**
Langley Research Center Hampton Va
AVIATION SAFETY TECHNOLOGY--FLIGHT SAFETY
A W Hall 804-827-3274
(505-44-13)

A technology base will be developed which can be used to

reduce the number of aviation accidents and to minimize the fatalities and damage resulting from accidents This will be accomplished by programs aimed at providing a data base for continued knowledge of the usage of various types of aircraft relative to their original design criteria Research on equipment and systems will be undertaken relative to flight-path control and meteorological phenomena Research will also be conducted to provide improved protection of the aircraft and its systems from hazards such a lightning turbulence and wind shear

W81-70110 **505-44-25**
Jet Propulsion Laboratory, Pasadena Calif
AVIATION SAFETY TECHNOLOGY - APPLIED FLUID MECHANICS
P F Massier 213-354-3549

The overall objective of this effort is directed toward improving aircraft fire safety The studies include those aspects of safety associated with (1) the development of a detailed fire modeling methodology for the prediction of aircraft fire characteristics and the associated dynamic response of materials in an accidental fire environment the analysis and prediction of the thermal characteristics of external pool fires resulting from post-crash fuel spills in order to characterize the fire hazards and the overall assessment of existing fire modeling capabilities for application to the post-crash aircraft fire scenario The studies will also include (2) the determination of rheological and other fluid properties of modified antimisting jet fuel which are responsible for inhibiting the ignition of fuel during a survivable aircraft crash the measurement of these properties so that the modified fuel can be quantified as to its antimisting behavior filterability and ignitability characteristics

W81-70111 **505-44-27**
Lyndon B Johnson Space Center Houston Tex
AIRCRAFT FIRE SAFETY AND TESTING
D E Supkis 713-483-3211
(534-05-17)

This RTOP consists of work originally started in FY-75 and continued through FY-80 The RTOP provides for development and testing new fire retardant non-metallic materials such as Electrical Wire Insulation Polymeric Molding Materials and Cargo Bay liners and the procurement of aircraft seats and components for testing functional size elements in the JSC 737 fuselage and the definition of toxicity testing techniques

W81-70112 **505-44-28**
Wallops Flight Center Wallops Island Va
AVIATION OPERATIONS SAFETY TECHNOLOGY - WIND SHEAR AND COLLISION AVOIDANCE
Robert E Carr 804-824-3411
(505-44-18)

The objective of this RTOP is to demonstrate the feasibility of using existing air carrier weather radar and other aircraft systems to provide the pilot with an airspeed/ground speed comparison as an aid in flying through wind shear conditions on landing and take-off and to further use these systems for the automatic detection and collision alert of an impending mid air collision in the terminal area State-of-the-art radar and microprocessor technology will be evaluated as a means of determining aircraft ground speed information through a combination of surface wind information up linked to the aircraft and vectorially added to the aircraft s airspeed Proven Automated Pilot Advisory System (APAS) technology will be evaluated as a technique for providing an Airborne Automated Traffic Advisory System (AATAS) as an aid to the pilot in avoiding mid air collisions

W81-70113 **505-44-29**
Marshall Space Flight Center Huntsville Ala
AVIATION OPERATIONS SAFETY TECHNOLOGY - APPLIED LASER TECHNOLOGY
E A Weaver 205-453-1597

Electro-Optic sensors using coherent light will be developed for application to aircraft operations and safety problems In FY-81 a study will be made of the very wide variation of atmospheric aerosol density the corresponding variation of the backscatter coefficient in the 9 to 11 micrometer wavelengths and their effects on the performance requirements of CO2 electro-optic Doppler sensors that are applied to aircraft operations and safety problems Remote measuring of atmospheric flow fields including Clear Air Turbulence (CAT) will use infrared coherent light electro-optic sensors Other coherent light frequencies will be used as defined by systems analysis studies of several aviation safety problems Indepth studies of specific problems will be made A beta experiment flight test and its results along with system engineering studies will identify the research hardware design specifications for producing the required feasibility demonstration sensor systems Proof of concept experiments will be conducted

W81-70114 **505-44-31**
Ames Research Center Moffett Field Calif
AIRCRAFT SYSTEMS OPERATIONAL SAFETY AND EFFICIENCY IMPROVEMENT
M A Golub 415-965-5953

The objective is to improve aircraft safety and efficiency through the use of advanced materials in aircraft tires This involves the development and evaluation of new tread and/or carcass formulations which will yield commercial and military transport aircraft tires having improved wear resistance traction blowout resistance and load-bearing characteristics compared to state-of-the-art tires based on natural rubber (NR) and cis polybutadiene (CB) Amorphous vinyl polybutadiene (VB) was found in laboratory track and flight tests to be a promising replacement for CB in tread stocks for Boeing 727 main landing gear tires Since the VB rubber used to date (prepared by Ziegler-Natta polymerization) proved to be inconsistent in properties new tread stocks will be compounded with NR and another VB (prepared by anionic polymerization) which is inherently capable of better uniformity and better properties than the Ziegler-Natta VB Aircraft tires retreaded with the optimum NR/anionic VB formulation(s) will be evaluated in track and flight tests Studies will be initiated on failure modes in aircraft tires and on risk assessment

W81-70115 **505-44-32**
Lewis Research Center Cleveland Ohio
COMMERCIAL AIRCRAFT FUEL SAVINGS
R Steinberg 216-433-6677

The objective is to demonstrate through impact studies that near real-time high resolution flight level windfield and temperature data can provide the basis for increasing the accuracy of the airline flight plan (minimum fuel track profile) and that this improvement can result in substantial savings in fuel for the airline industry To achieve this objective comparisons will be made between flight plans developed from the present operational data base and those developed from enroute high resolution wind and temperature data These results will then be evaluated against actual data provided by participating airlines The minimum fuel track requirement for the flight plan provides unique criteria with which to translate the results of these comparisons directly into fuel savings for air carriers The high resolution windfield and temperature data base required for this impact study has become available for the first time along several major airline routes as a result of an international meteorological experiment which began in December 1978 and was concluded in November 1979

W81-70116 **505-44-33**
Langley Research Center Hampton Va
AIRCRAFT LANDING SYSTEMS EFFICIENCY IMPROVEMENTS
J L McCarty 804-827-2796

The specific objective is to examine new concepts and techniques which offer potential for reducing both operational complexities and costs of aircraft landing systems with a view toward use of the improved systems by large and small civil aircraft Aircraft operations on prepared runways under adverse weather conditions and on certain unprepared surfaces present requirements of braking and steering systems tires and the runway that are vital to aircraft safety and passenger comfort The objectives of programs covered by this RTOP are (1) to improve the performance of braking systems (2) to improve

the wet traction and lifetime of pneumatic tires (3) to develop new landing gear systems that would permit operations on unprepared fields including water and permit continuous use of prime runways for all-weather operations (4) to evaluate tire cornering behavior with and without braking such that high-speed turnoffs can be designed to increase the flow of traffic at congested airports and (5) to relate the character of the runway surface to aircraft braking and steering performance Research to meet these objectives will employ full-scale aircraft landing gear systems and subsystems, and scaled pneumatic tires The landing loads track will be the primary test facility

Aeronautics Systems Technology Programs

W81-70117 **510-53-12**
Lewis Research Center Cleveland Ohio
MATERIALS FOR ADVANCED TURBINE ENGINES (MATE)
Charles P Blankenship 216-433-6922
(505-33-12)

The MATE program is a cooperative Government-industry effort to help introduce new materials technologies into advanced aircraft turbine engines in order to more rapidly achieve potential economic and operational performance advantages The general objective is to advance the development of selected materials technologies to help meet the needs of engines expected to be introduced into service in the 1980-90 time frame The program is specifically aimed at accelerating the transfer of at least ten materials technologies from the laboratory-feasibility stage to engine-demonstration testing This will be done through scale-up of selected materials technologies to allow the reliable manufacture and rig testing of engine components and the subsequent verification of their potential performance improvements in ground based engine tests Cost/benefit and risk analyses are conducted to help guide the selection of the best candidate materials The program is conducted through contracts with the domestic aircraft turbine engine industry

Materials and Structures Systems Technology

W81-70118 **510-54-13**
Langley Research Center Hampton Va
INTEGRATED PROGRAMS FOR AEROSPACE-VEHICLE DESIGN (IPAD)
R E Fulton 804-827-2887
(505-33-63)

The objectives of this RTOP are to reduce vehicle design cycle time and design costs in the 1980 s through development of components of a computer software system denoted IPAD for the total management of aerospace-vehicle design processes System design and prototype software will demonstrate a 25% reduction in flow time for vehicle preliminary design tasks a 50% reduction in man-hours to assemble engineering data for component design and a 25% reduction in time and cost to generate engineering drawing data The Industry Technical Advisory Board (ITAB) will review and critique development work and will be provided software components for evaluation and use as they are developed Continued coordination will be maintained with the Air Force Integrated Computer Aided Manufacturing (ICAM) program to maximize benefits from the two programs

W81-70119 **510-55-12**
Lewis Research Center, Cleveland Ohio
AEROELASTICITY OF TURBINE ENGINES
C L Ball 216-433-6835
(505-32-52 505-32-22 505-33-52)

The aeroelastic program is directed towards improving flutter boundary design criteria so that the occurence of flutter in fans and compressors for advanced propulsion systems is essentially avoided If flutter is encountered these criteria may also be used to expeditiously clear flutter from the operating region The program will also provide through analytical and experimental research a more fundamental basis for reliable analysis prediction and thus the avoidance of instability regions Analytical methods and computer codes will be developed to predict the unsteady aerodynamic forces under various flutter conditions and to calculate the structural modes of blades shrouds and disks as utilized in fans and compressors for advanced engines The unsteady aerodynamic analysis will be verified in cascades in which the blades are driven as if they are in flutter The structural analysis will be verified in a vacuum spin rig and vibration rigs The coupling of the aerodynamic forces and structure will be verified in suitable instrumented experimental fans The prediction method will be further verified by application to realistic data such as that obtained in full-scale engine research programs This aeroelastic program is the NASA portion of an interdependent and coordinated program involving LeRC and AFAPL The effort involves inhouse projects as well as contract research with aerospace companies and grants to various universities

W81-70120 **510-57-12**
Lewis Research Center Cleveland Ohio
TURBINE ENGINE HOT SECTION TECHNOLOGY (HOST)
M H Hirschberg 216-433-4000
(505-33-22)

The HOST program will develop the analytical tools needed for improving the prediction of the durability of combustor liners and turbine vanes and blades of advanced aircraft turbines It will demonstrate that these models and predictive tools describe the complex environment and loading conditions to which these components are subjected more accurately than is currently possible

Propulsion Systems Technology

W81-70121 **511-55-12**
Lewis Research Center Cleveland Ohio
ADVANCED LOW EMISSION COMBUSTOR (ALEC)
D A Petrash 216-433-6860
(505-32-32 505-32-72)

The objective is to evolve lean premixed prevaporized combustion technology into a practical aircraft gas turbine engine combustion system that exhibits superior performance high durability fuel flexibility and environmentally acceptable pollutant emissions over the entire flight envelope Oxides of nitrogen emissions will be reduced by operating the combustion system at extremely lean fuel-air mixtures Initially fundamental in-house grant and contract studies examined practical problems associated with this technique and combustor constraints imposed by the engine With the design information from the initial studies combustor concepts are being integrated into engine system designs for assessment Concepts which show potential for achieving program goals will be tested and screened The most promising designs will be refined through component tests possibly leading to an engine verification

W81-70122 **511-58-12**
Lewis Research Center Cleveland Ohio
HELICOPTER TRANSMISSION TECHNOLOGY
E V Zaretsky 216-433-6101
(505-32-42 506-53-12)

The objectives of this work are (1) to demonstrate improvements in weight noise reliability maintenance cost and size of helicopter transmissions (2) to demonstrate compactness reduced noise and reliability characteristics of hybrid traction drive systems and (3) to demonstrate transmission life increase of 200 percent with conventional drive systems through the application of advanced technology power transfer components

W81-70123 **511-59-12**
Lewis Research Center Cleveland Ohio
BROAD PROPERTY FUELS TECHNOLOGY
J Grobman 216-433-6229
(505-03-22 511-55-02 505-32-72)

The objectives of this effort are to evolve and demonstrate the combustor technology required to utilize broad property fuels in current and next generation commercial jet aircraft The intention of this project is to extend the current R and T base Fuels Research Program being performed through RTOP 505-32-72 to an integrated component investigation resulting in engine verification tests of fuel flexible advanced combustors The engines selected are advanced high-bypass ratio turbofan designs The effort is being conducted through multi-phase contracts using two parallel contractors Pratt and Whitney and General Electric throughout the length of the project The technical conduct of this project effort will be similar to the multi-phase approach used in the NASA Experimental Clean Combustor Program The multi-phase contract effort will consist of three consecutive phases which will systematically screen out the more promising combustor and associated fuel system concepts for using broad property fuels (Phase I) evolve these concepts into component hardware which is compatible with an existing engine (Phase II) and perform actual verification tests to document engine performance and durability (Phase III)

Avionics and Flight Controls Systems Technology

W81-70124 **512-54-11**
Ames Research Center Moffett Field Calif
ADVANCED GUIDANCE AND CONTROL SYSTEMS VALIDATION TECHNOLOGY
H C Lessing 415-965-5567
(532-06-11 505-34-43)

The objectives of this joint NASA/FAA program are to improve the Government s understanding of digital flight control system (DFCS) verification and validation (V and V) technology and to evaluate and improve DFCS V and V tools and techniques The approach involves the development adaptation evaluation and improvement of present and promising state-of-the-art redundant DFCS verification and validation tools and techniques utilizing a representative near-term Redundant DFCS (RDFCS) facility to support this effort Automatic software verification tools plus hardware verification and system validation tools/techniques are included A series of workshops will be held to keep the FAA abreast of this technology and to summarize the results of each major program element to industry and Government

W81-70125 **512-54-14**
Hugh L Dryden Flight Research Center Edwards Calif
ADVANCED GUIDANCE AND CONTROL FLIGHT SYSTEMS EXPERIMENTS
C R Jarvis 805-258-3311
(505-34-34)

The overall objective of this effort is to provide the technology necessary for the implementation of advanced reliable digital flight control systems in future aircraft The program involves the development and demonstration of a unique flight test facility and its use in carrying out experiments to exploit state-of-the-art advancements in digital technology The facility allows flight test evaluation in an operational environment of unique advanced control law concepts failure management techniques and operational procedures Present activity is directed toward evaluation of innovative failure management techniques which take advantage of the increased computational capability of digital systems in achieving a higher degree of system realiability and integrity

Aeronautical Systems Studies

W81-70126 **530-01-13**
Langley Research Center Hampton Va
GENERAL AVIATION SYSTEM TECHNOLOGY STUDIES
R J Tapscott 804-827-3216

The objective of this work is to undertake studies to evaluate missions and aircraft design concepts in order to identify the technology requirements for increased performance productivity and safety of general aviation aircraft These studies will identify the design and operational systems requirements, and attendant costs and benefits for existing as well as for future general aviation aircraft missions

W81-70127 **530-02-11**
Ames Research Center Moffett Field Calif
LOW SPEED AIRCRAFT SYSTEMS STUDIES
J Zuk 415-965-6569
(505-42-71 532-05-11 530-02-18 505-42-51 532-06-11)

The general objectives of this RTOP are (1) to assess rotorcraft (including Hybrid Airship (HA)) and V/STOL aircraft mission requirements growth patterns markets foreign competition productivity criteria and national needs/benefits of importance in the definition of integrated agency programs (2) to assess technology that will substantially improve operational suitability of existing or derivative conventional rotorcraft in the areas of vibration noise safety costs etc and (3) to assess advanced vehicle configuration concepts in rotorcraft and V/STOL aircraft which offer performance and operational advantages for civil and military applications The results of these studies will provide data and identify promising research options for incorporation into long-range NASA low speed aircraft program planning

W81-70128 **530-02-18**
Wallops Flight Center Wallops Island Va
AIRBORNE EXPERIMENT PLATFORMS
H C Needleman 804-824-3411

This study effort is directed toward establishing the utility and technology requirements of two classes of unmanned airborne experiment platforms - high altitude powered platforms including heavier-than-air and lighter-than-air vehicles and unpowered platforms including tethered and mid-air-deployed balloon-borne platforms - for use by the scientific and applications experimenter community as tools to complement existing research techniques User applications mission concepts and system concepts will be investigated with emphasis on high altitude and deployment operations compatibility with science user requirements and system integration

W81-70129 **530-04-12**
Lewis Research Center Cleveland Ohio
PROPULSION SYSTEMS FOR SMALL TRANSPORTS
R J Weber 216-433-4000

This RTOP covers the propulsion efforts at Lewis in support of the Small Transport Advanced Technology (STAT) program led by the Ames Research Center Studies are performed to identify engine and propeller designs suitable for commuter aircraft Selected component research is subsequently carried out to advance the various technologies that are found to be most beneficial

W81-70130 **530-04-13**
Langley Research Center Hampton Va
LONG HAUL TRANSPORT AIRCRAFT SYSTEMS STUDIES
C Driver 804-827-3216

The objective will be to provide technology for advanced transport aircraft and aircraft systems through studies and evaluations of (1) all-new total aircraft configurations and concepts (2) promising new subsystem concepts in advanced aircraft configurations (3) semi-developed technologies for aircraft applications and opportunities (4) transportation system interactions with avionics other subsystems and aircraft (5) operational aspects of aircraft systems in areas significant to advanced technology and (6) market demands and economics as impacting needs for aircraft These studies covering future needs for both

passenger and cargo transports are aimed at improving aircraft economics fuel use noise emissions airport congestion and traveler acceptance and providing an information base for technology program planning in support of improved near-term and future long-haul air transportation systems for civil and military purposes Both in-house and contractual efforts will be utilized

W81-70131 **530-05-12**
Lewis Research Center Cleveland Ohio
ADVANCED PROPULSION SYSTEM CONCEPTS
R J Weber 216-433-4000

Studies will be performed of engine cycles complete propulsion systems and integrated engine/airframe combinations applied to representative airplane missions The object of the studies is to determine desirable engine component and system design characteristics for future aircraft and to identify technology deficiencies and profitable areas for research The studies will explore the opportunities for satisfying environmental and natural resource constraints and their related impact on propulsion system selection and aircraft performance

General Aviation Systems Technology

W81-70132 **531-01-11**
Ames Research Center Moffett Field Calif
GENERAL AVIATION ADVANCED AVIONICS SYSTEMS
D G Denery 415-965-5438
(531-01-12 532-01-11)

The objective of this program is the design and demonstration of a totally integrated advanced low cost avionics system to enhance the safety reliability and utility of future general aviation aircraft The approach is to synthesize various subsystem concepts and conduct supporting studies of the projected microelectronic and fluidic technology aircraft design and air traffic control environment of the 1980s to formulate a system definition which can be scrutinized against requirements and cost-benefit criteria to formulate final specifications and designs The system design will be verified in simulations and flight tests with active participation of the FAA and the aviation industry This is a joint program between Ames Research Center (ARC) and Langley Research Center (LaRC) The lead center is ARC who in addition to subsystems development is responsible for the overall final system design fabrication simulations and flight tests LaRC is responsible for the development of fluidic and other avionic subsystems with emphasis directed towards the light aircraft end of the general aviation spectrum

Low-Speed Systems Technology

W81-70133 **532-01-11**
Ames Research Center Moffett Field Calif
ROTORCRAFT OPERATING SYSTEMS TECHNOLOGY
G Xenakis 415-965-5430
(505-34-11 532-05-11)

The objective of this research is to provide the critical technology to allow rotorcraft operating under instrument meteorological conditions (IMC) to have operating performance comparable to performance under visual meteorological conditions (VMC) By accomplishing this objective it is expected that system safety will be improved and productivity increased The research program will be based on needs requirements and operating experience of the users in coordination with the FAA and industry Systems concepts will be defined constructed and evaluated through simulations controlled flight research under highly instrumented conditions and operational flight assessments There are three main all-weather rotorcraft system technology thrusts These are (1) remote sites on-board systems technology (2) navigation and guidance concepts and operating systems research for operations into high density terminal areas and integrated category 3 systems and (3) investigations of XV-15 advanced rotorcraft operating systems On-board systems technology will be developed and validated for IMC approach guidance and navigation to off-shore and on-shore remote sites Guidance and navigation concepts and operational procedures will be investigated that allow use of airspace separate from that used by conventional takeoff and landing (CTOL) traffic Emphasis will be on the exploration and development of concepts that will allow rotorcraft to operate IFR with the same utility and flexibility that they currently have under VFR

W81-70134 **532-02-11**
Ames Research Center Moffett Field Calif
QUIET PROPULSIVE-LIFT TECHNOLOGY EXPERIMENTS - AIRCRAFT PERFORMANCE AND OPERATING SYSTEMS RESEARCH
J Cochrane 415-965-5662

This program will furnish the U S Government and aircraft industry with flight data to develop certification criteria and design methods for civil propulsive-lift short-haul transports It will take maximum advantage of civil-military STOL/RTOL transport commonality The program will develop advanced technology for propulsive-lift short-haul transport applications which will benefit civil derivatives of future-generation military STOL transports and future civil propulsive lift R/STOL transports Broad flight experiment areas involve (1) correlation of methods for predicting vehicle characteristics with flight-measured characteristics (2) studies of certification criteria for quiet propulsive-lift transport (QPLT) and (3) studies of flight control systems cockpit displays and navigation system requirements for STOL/RTOL terminal area flight operations These experiments will be conducted through a flight test program using the quiet short-haul research aircraft (QSRA) A small part of the QPLT effort includes ground-based technological efforts to support and/or compliment flight activities Most of the flight experiments will be conducted on the QSRA with the approach being to utilize the QSRA as a national propulsive-lift flight facility

W81-70135 **532-02-12**
Lewis Research Center Cleveland Ohio
QPLT SYSTEMS TECHNOLOGY
M F Valerino 216-433-6604

This RTOP provides for Lewis Research Center participation in the NASA Quiet Propulsive Lift Technology (QPLT) Experiments Program which includes flight research experiments in the areas of propulsion system performance and noise to be conducted using the NASA Quiet-Short-Haul Research Aircraft (QSRA) Emphasis will be on propulsion acoustics including measurements of the engine installation effects the fan-inlet treatment suppression characteristics and the effects of forward velocity on the farfield noise characteristics Also consideration will be given to obtaining in-flight air turbulence data for correlation with fan-inlet noise generation The flight measurements will be made through a cooperative effort with Ames Research Center In addition continuing QSRA propulsion support will be provided

W81-70136 **532-03-11**
Ames Research Center Moffett Field Calif
ADVANCED ROTOR SYSTEMS TECHNOLOGY/RSRA OPERATIONS
H K Edenborough 415-965-6567
(505-42-21 530-02-01 532-06-11)

The objective of this systems technology program is to provide and validate integrated rotor system technology required to substantially improve the performance utility efficiency dynamics noise maintainability and ownership cost of civil and military helicopters through system design studies focused small and large scale tests in ground-based facilities and selected flight tests of current state-of-the-art rotors and advanced concept rotor systems The goals of this program are to (1) advance the aerodynamics and structural dynamics technology of rotor blades to increase performance and efficiency and to reduce noise vibration weight cost and control system requirements (2) improve rotorcraft gust response and flight stability and control characteristics through utilization of active rotor control and composite construction technologies (3) expand the ground-based facility data base on rotors of opportunity and on a family of new blades having systematic variations in aerodynamic design

parameters (4) expand the flight data base on existing rotors that can be readily adapted for evaluation on RSRA (and other test rotorcraft) and (5) expand the design criteria for rotor and rotor control systems to improve rotorcraft handling quantities through high fidelity moving-base simulations

W81-70137 **532-04-11**
Ames Research Center Moffett Field Calif
TILT ROTOR RESEARCH AIRCRAFT FLIGHT INVESTIGATIONS
D D Few 415-965-5445

For several years NASA and the Army have been engaged in a joint effort to advance the technology of tilt rotor V/STOL aircraft The significant ongoing effort is the NASA/Army XV-15 Tilt Rotor Research Aircraft (TRRA) Project The project aircraft development and Airworthiness Flight Testing were completed in 1979 The Flight Investigation Program POC flight tests to be completed in 1981 will satisfy the objectives of the project namely verify rotor/pylon/wing dynamic stability and performance establish a safe operating envelope assess handling qualities investigate gust sensitivity and investigate the effect of disk loading and tip speed on downwash and noise in hover mode The goal of this Flight Investigation Program is to provide the U S aircraft community the design criteria and operational data required for the development certification and operation of Tilt Rotor V/STOL Aircraft with low technical risk This will be accomplished by conducting high risk proof-of-concept testing at Dryden and then conducting flight tests of military and civil mission profiles near terminal operations and detailed handling qualities evaluations at Ames or nearby government facilities Also at Ames flight experiments involving automatic landing and guidance and navigation will be conducted Studies will be conducted in areas where new technology holds promise for significant payoff when applied to tilt rotor aircraft Correction of minor aircraft deficiencies will be accomplished at Ames

W81-70138 **532-04-14**
Hugh L Dryden Flight Research Center Edwards Calif
FLIGHT TEST OF THE TILT ROTOR RESEARCH AIRCRAFT
W D Painter 805-258-3311

This RTOP covers Dryden Flight Research Center (DFRC) support to Ames Research Center (ARC) for the flight test of the Tilt Rotor Research Aircraft (TRRA) program DFRC will support a joint flight-test team with Flight Operations and Support and Engineering directorates as needed to successfully complete the flight-test program This plan covers the conduct of all proof-of-concept flight testing of the XV-15 Tilt Rotor Research Aircraft at DFRC considering the overall technical objectives manpower funding and program schedules

W81-70139 **532-05-11**
Ames Research Center Moffett Field Calif
V/STOL SYSTEMS TECHNOLOGY
A Faye 415-965-6373
(505-10-31 505-06-51 505-06-61 791-40-21)

The objective of this RTOP which is a companion to RTOP 505-42-71 is to provide the systems technology required to enable the development of military and civil aircraft having V/STOL capability and viable mission performance Theoretical and experimental configuration-dependent technology development will be undertaken in the areas of high-speed aerodynamics low-speed aerodynamics and flight dynamics Critical areas of aerodynamic uncertainty are being identified to guide future research efforts To insure that all major high-speed propulsion system/airframe interactions are accounted for properly compact propulsion simulators will be incorporated into the high-speed scale-model experimental investigations of potential V/STOL configurations Low-speed aerodynamics research will concentrate on the aerodynamic characteristics of high performance powered-lift configurations development of high performance augmentors for V/STOL application and providing design criteria for the development of V/STOL nacelles Flight control system and display requirements will be investigated for specific configurations primarily through piloted simulation Studies will be conducted to define designs and cost estimates for several V/STOL research aircraft concepts

W81-70140 **532-05-12**
Lewis Research Center Cleveland Ohio
V/STOL PROPULSION SYSTEM TECHNOLOGY
Carl C Ciepluch 216-433-6644
(505-42-62 532-05-11)

The development of viable military and civil aircraft having vertical-takeoff-and-landing (VTOL) capability in addition to performance capabilities approaching those of current operational aircraft (CTOL) requires the development of additional propulsion system technology Two propulsion industry contractors have been selected to develop math models and control logic for advanced supersonic V/STOL propulsion systems These efforts will lead to future piloted simulations at NASA Ames System architecture studies will be conducted by competitively selected teams consisting of aircraft propulsion and digital system companies Key technology programs will also be undertaken by NASA to support V/STOL propulsion development using funds provided by the Navy The programs will be outlined in the joint Navy/NASA document formalizing the work The program could include aerodynamic testing of fans inlets thrust deflectors ejectors and thrust control devices

W81-70141 **532-06-12**
Lewis Research Center Cleveland Ohio
ADVANCED ROTORCRAFT PROPULSION TECHNOLOGY
Carl C Ciepluch 216-433-6644
(505-42-21 505-42-31 530-02-11 505-44-12 511-58-12)

One part of the NASA Advanced Rotorcraft Technology Program is concerned with developing propulsion technology This effort includes work in the areas of engine components transmissions and propulsion system integration The objectives of this program are to improve propulsion system durability reliability and cruise fuel consumption to reduce life cycle costs to develop propulsion technology unique to high productivity vehicles and to increase operational capability and flexibility The engine component program will include work in compressors combustors turbines controls icing and diagnostics These efforts will include developing design methods and confirming them in experimental component tests Advanced concepts will also be experimentally evaluated The transmission program will involve developing design methods for advanced transmission components experimentally verifying these design methods and performing selected flight test evaluations The system integration effort will include evaluating advanced components in an engine system and the integration of a number of advanced technologies into an experimental engine for evaluation and demonstration of technology readiness

W81-70142 **532-06-13**
Langley Research Center Hampton Va
ADVANCED ROTORCRAFT SYSTEMS TECHNOLOGY-MATERIALS AND NOISE
H B Dexter 804-827-2869
(505-42-13)

The objectives of this research are to develop advanced composites technology for low-risk primary helicopter airframe designs that provide increased vehicle efficiency and productivity through reduced fuel consumption and life-cycle costs along with increased payload and mission capability to develop the technology for reducing the interior noise of helicopters through transmission/mainframe isolation and to develop the technology for improving rotor noise prediction methodology through the acquisition of model scale performance pressure loading and acoustic data NASA will participate with the U S Army in a cooperative effort to develop composites with major emphasis on aggressive design and fabrication concepts beyond the current state-of-the-art technology Contract studies will be performed of rotorcraft interior noise with emphasis on quantifying the noise radiated by the transmission and attenuating this noise by means of isolator systems In the noise prediction area model scale performance pressure loading and acoustic data will be acquired in the Langley V/STOL tunnel for the purpose of developing and validating first principles noise prediction methods to guide

a Langley/Ames cooperative flight experiment using the RSRA and to validate wind-tunnel technology for use in determining the performance and noise characteristics of new rotorcraft

High-Speed Systems Technology

W81-70143 **533-01-11**
Ames Research Center Moffett Field Calif
FUEL TANK SEALANTS
R W Rosser 415-965-5244

Fuel tanks sealants will be developed which offer improved service life under conditions encountered in advanced supersonic aircraft when compared to state-of-the-art materials The specific objective is to obtain pilot plant quantities of characterized and useful sealant materials for flight test evaluation The goal will be accomplished through a series of steps as follows Produce a fluoroether prepolymer in the 20 lb range convert it to a gum stock containing an appropriate cross-linking formulate the sealant elastomer into a material suited to a fillet seal application and apply the fluoroether sealant to flight simulation studies and develop a performance specification from actual flight tests Finally the technology base will be increased by utilizing new flouroether materials to modify polymeric systems such as composite resins and adhesives for expanded applications

W81-70144 **533-01-13**
Langley Research Center Hampton Va
SCR-MATERIALS AND STRUCTURES
T T Bales 804-827-4581
(505-33-63 505-33-73 505-33-13 505-33-23 505-33-33 505-33-53)

The objective is to establish a supersonic materials and structures technology base by developing capability in structural concepts and design loads aeroelasticity and materials fatigue and manufacturing methods The development of capability for computer-aided analysis and synthesis will be undertaken and validation of the computer design tools and methodology by applications to supersonic cruise configurations will be made Advanced transonic/supersonic aeroelastic load prediction methods will be developed and a description of high altitude atmospheric turbulence environment obtained Included also is work on strength fatigue and fracture and damage-tolerance to establish structural integrity of materials and representative components application of advanced resins and adhesives and performance of time-temperature-stress studies of composites and development of fabrication methods for composites and titanium with emphasis on superplastic forming The technology from this program will permit major reductions in structural weight improved structural integrity and lower cost for supersonic cruise aircraft

W81-70145 **533-01-14**
Hugh L Dryden Flight Research Center Edwards Calif
SCR MATERIALS AND STRUCTURES FLIGHT RESEARCH
Berwin M Kock 805-258-3311

The objective of this activity is to advance the technology related to structures and materials suitable for high speed cruise and/or high temperature applications Airframe component parts will be manufactured laboratory tested and installed on airplanes for flight validation Components will be manufactured of both metallic and composite materials Flight tests will be conducted to validate laboratory and analytical results In flight measurements will be obtained on a structural mode control system at supersonic speeds These measurements will be obtained on a B-1 airplane

W81-70146 **533-01-32**
Lewis Research Center Cleveland Ohio
SCR PROPULSION TECHNOLOGY
R J Weber 216-433-4000

Advances in propulsion system technology will be required to permit the development of a quiet clean economical commercial supersonic transport Contracts for the study of such airplanes have been let by Langley Research Center and other supporting work is being performed at each of the NASA Research Centers As part of that effort LeRC is studying the propulsion system in order to define the most desirable engine cycle identify technology requirements and advance the various component disciplines peculiar to supersonic flight to the point where design of an experimental engine (VCEE) could be undertaken when desired The effort involves in-house and contracted research in engine cycles noise and pollution stability and control materials and various unique components

W81-70147 **533-01-43**
Langley Research Center Hampton Va
SRC - AERODYNAMIC PERFORMANCE TECHNOLOGY
C Driver 804-827-3216

The objectives of this program are to advance the state of the art in supersonic aerodynamics through the generation of comprehensive data bases on promising advanced supersonic configuration concepts and through the development of better tools for aerodynamic design and analysis Aerodynamic advances resulting from this program will be studied in concert with technology advances in the related disciplinary areas of propulsion structures and materials and controls through detailed technology integration studies of representative supersonic cruise aircraft concepts Throughout the studies major consideration will be given to the factors which influence and improve the noise sonic boom energy efficiency and overall performance of potential future supersonic cruise aircraft Objectives of the program will be accomplished through support of in-house industry and university approaches to the development of new design and analysis methods and through wind tunnel tests of both industry and NASA designed supersonic cruise configurations In-house and industry technology integration teams will assess the applicability and potential payoff of advanced supersonic technology to an adequate depth so as to provide reliable direction to future research efforts

W81-70148 **533-01-62**
Lewis Research Center Cleveland Ohio
PROPULSION SYSTEM/AIRFRAME INTEGRATION TECHNOLOGY
D N Bowditch 216-433-6123

Present inlet concepts in inlet-engine-airframe integration methods will be evaluated and the generation of advanced concepts and methods will be initiated Inlet and inlet control analysis-design methods will be assembled and evaluated Existing subscale inlet hardware (as is or modified) will be tested to verify analysis methods and to provide a data base for areas such as low speed aeroacoustics and high speed off-design and angle of attack performance These studies and tests will be conducted both in-house and on contract to supersonic cruise research and variable cycle engine contractors This effort is a precursor to the 1983 Nacelle/Airframe Integration new start

W81-70149 **533-01-63**
Langley Research Center Hampton Va
SCR - AIRFRAME/PROPULSION SYSTEM INTERACTIONS
C Driver 804-827-3216

Model variable cycle engines have been defined in previous supersonic cruise research (SCR) supported studies for possible application to commercial supersonic transport aircraft The extended flow variability made possible by such engines require greater versatility of the inlet and exhaust nozzle than for conventional engines The range of flexibility of all propulsion system components need to be defined such as to maximize internal thrust and minimize nacelle and interference drag throughout the flight regime As part of the SCR program a study of the integration problem of the propulsion system will be made to identify technology requirements and advance the various component disciplines to the point where intelligent choices can be made The effort involves in-house and contracted research on isolated inlets and nozzles as well as the mutual installation effects on complete airplane configurations This effort will be a cooperative and coordinated endeavor of both Langley and Lewis Research Center

W81-70150 **533-02-14**
Hugh L Dryden Flight Research Center Edwards Calif
ADVANCED FLIGHT EXPERIMENTS ADVANCED FIGHTER TECHNOLOGY INTEGRATION/F111 (AFTI/F-111)
L J Caw 805-258-3311

The objective of this program is to conduct a series of flight experiments Dryden Flight Research Center will operate an F-111 aircraft and conduct an investigation of the mission adaptive wing (MAW) as a part of the joint NASA Air Force AFTI-111 Program Dryden will participate in design review develop and operate instrumentation and define flight test plans

W81-70151 **533-02-24**
Hugh L Dryden Flight Research Center Edwards Calif
HIGH PERFORMANCE AIRCRAFT FLIGHT TEST SUPPORT
Berwin M Kock 805-258-3311

The objective is to provide flight test support for high speed aircraft experiments This will be accomplished by maintaining a baseline capability with a high performance aircraft that can be easily used to accommodate specific flight projects or experiments The baseline support will include contractor maintenance support instrumentation system operation basic maintenance and fuel

W81-70152 **533-02-34**
Hugh L Dryden Flight Research Center Edwards Calif
ADVANCED FLIGHT EXPERIMENTS F-14 HIGH ANGLE-OF-ATTACK
H J Smith 805-258-3311

The objective of this project is to conduct a number of flight test experiments in cooperation with the Navy and other NASA Centers which will benefit the F-14 while enhancing NASA s high angle-of-attack (AOA) technology These experiments include an evaluation of an aileron-rudder-interconnect flying qualities investigation high AOA parameter identification simulation validation study engine-airframe compatability study and an investigation of the F-14 air data system at high angles-of-attack

W81-70153 **533-02-44**
Hugh L Dryden Flight Research Center Edwards Calif
INTEGRATED RESEARCH AIRCRAFT CONTROL TECHNOLOGY
B M Kock 805-258-3311

The overall objective of the Integrated Research Aircraft Control Technology (INTERACT) project is to demonstrate through flight a generically applicable control development process for interactive propulsion flight control systems To exercise this process for interactive modes will be developed through which measurable improvements can be verified The control modes will be implemented on a high performance aircraft using hardware of convenience The project consists of three phases a study activity (Phase 1) the implementation effort for development of the flight system (Phase 2) and subsequent research flight testing (Phase 3)

W81-70154 **533-02-64**
Hugh L Dryden Flight Research Center Edwards Calif
AFTI/F-16
Shu W Gee 805-258-3311

The overall objective of the Advanced Fighter Technology Integration/F-16 (AFTI/F-16) program is to quantify the benefits and penalties of the individual and integrated technologies proposed to improve weapon system effectiveness and survivability by flight demonstration of air-to-air and air-to-surface offensive and defensive mission roles The Digital Flight Control System (DFCS) Integrated Flight/Fire Control (IFFC) and Pilot-Vehicle Interface (PVI) technologies are being implemented in a modified F-16 to allow flight evaluation of such non-classical control modes as direct lift and side force flat turn fuselage pointing and uncoupled independent control of aircraft rotation and translation The AFTI/F-16 airplane will be flight tested and evaluated by a joint Dryden USAF and contractor flight test team and will be operated and maintained by Dryden from Dryden facilities

W81-70155 **533-02-73**
Langley Research Center Hampton, Va
DECOUPLER PYLON FLIGHT DEMONSTRATION
W H Reed III 804-827-2265
(505-33-53)

A joint program between Langley Research Center and Dryden Flight Research Center has the objective to demonstrate the suppression of wing/store flutter using the decoupler pylon concept on an advanced high performance airplane The concept has been verified in wind tunnel studies The purpose of the flight studies is to subject the concept to the effects of the full flight environment including maneuvering and atmospheric gusts while assessing the alleviation of the store flutter problem and to evaluate the dynamic characteristics of the wing-store-decoupler pylon system The decoupler pylon will be designed and fabricated under contract and flight tested at the Dryden Flight Research Center The Langley Research Center will exercise technical management of the study

W81-70156 **533-03-13**
Langley Research Center Hampton Va
HIGHLY MANEUVERING AIRCRAFT TECHNOLOGY
W P Henderson 804-827-2676

The objective of this research is to promote and stimulate the application of new and innovative technologies in a multidisciplinary manner so as to exploit to the highest practical degree the synergistic potential of the new technologies for the design of future fighter aircraft A vital part of this research will be to support the ongoing NASA Highly Maneuverable Aircraft Technology (HIMAT) programs The study of the highly integrated canard-wing concept will be pursued with the objectives of defining the stability and control characteristics at high angles of attack Promising ideas for obtaining high aerodynamic performance for maneuvering fighter aircraft will be examined analytically and experimentally with primary emphasis on investigating their aerodynamic performance propulsion stability and control characteristics Representative promising concepts which will be incorporated into the basic canard-wing concept include a high aspect ratio two dimensional vectoring nozzles utilized to enhance the maneuvering performance of the aircraft or to provide control forces such that the large radar reflecting control surfaces can be eliminated and anti-spin devices The experimental studies will be conducted in the Langley 16 foot and full scale tunnel

Transport Aircraft Systems Technology

W81-70157 **534-01-13**
Langley Research Center Hampton Va
LAMINAR FLOW CONTROL
R J Muraca 804-827-2045

The broad objective of this laminar flow control (LFC) element of the NASA Aircraft Energy Efficiency (ACEE) program is to develop and demonstrate a practical reliable maintainable laminar flow control system for viscous-drag reduction of future commercial transport aircraft The technology developed will be applicable to although insufficient for military transports The LFC element of ACEE consists of three separate but related phases (1) definition of candidate LFC system concepts for application to future production aircraft (2) subsystem development and evaluation and (3) design fabrication and flight demonstration of integrated LFC systems in a validator aircraft The Phase 1 effort was concluded in September of 1978 The Phase 2 activities which are to be accomplished in fiscal years 1979 through 1984 are covered by this RTOP

W81-70158 **534-01-14**
Hugh L Dryden Flight Research Center Edwards Calif
LAMINAR FLOW CONTROL (LEADING EDGE GLOVE) - FLIGHT RESEARCH
R S Baron 805-258-3311

The objective is to demonstrate by flight research the effectiveness of LFC leading edge system under representative flight conditions up to Mach 0 8 and 40 000 feet Two different

contractor LFC Leading Edge Systems (including suction cleaning and deicing systems) will be installed in the leading edge of both wings of the JetStar Aircraft The LFC Leading Edge test articles will be designed and fabricated to demonstrate that required LFC systems can be packaged into a leading edge section of a wing representative of future LFC commercial transport aircraft After the test articles are installed in the aircraft a series of ground and flight tests will be performed to insure the laminar flow performance and also to verify operational capability of the LFC contractor systems

W81;70159 **534-02-11**
Ames Research Center Moffett Field Calif
ENERGY EFFICIENT TRANSPORT WIND TUNNEL TESTING
Frank W Steinle 415-965-5850
(534-02-03)

Technical assistance consultive services and support through the use of NASA-Ames facilities will be provided to NASA-Langley for the Energy Efficient Transport Project (EET) Support tests will be primarily conducted in the Ames 11- by 11-Foot Transonic and 12-Foot Pressure Wind Tunnels

W81-70160 **534-02-13**
Langley Research Center Hampton Va
ENERGY EFFICIENT TRANSPORT
R V Hood 804-827-2396

This project will expedite industry acceptance and application of Advanced Aerodynamics and Active Controls Technology in an integrated manner to achieve significant energy economic and aircraft sales benefits In-house and industry experimental and analytical efforts will be continued in the areas of supercritical aerodynamics high-lift systems propulsion/airframe integration and wing/empennage/flight control systems The industry activities are oriented both at near term derivative aircraft product improvements and farther-term new aircraft development The in-house activities are generally focused on the longer-term new generation aicraft technologies that have higher potential benefits with commensurately higher risk Emphasis will be placed on technologies having the greatest benefits to long-haul subsonic derivatives and new transport aircraft

W81-70161 **534-02-14**
Hugh L Dryden Flight Research Center Edwards Calif
ENERGY EFFICIENT TRANSPORT FLIGHT RESEARCH
M R Barber 805-258-3311

This RTOP covers three separate elements as follows (1) flight tests of Whitcomb Winglets on a KC-135 aircraft (2) development of a system integration technique resulting in the design of an active control system that will provide gust alleviation maneuver load control and flutter suppression for the Aeroelastic Research Wing Vehicle (ARW-2) and (3) determination of the extent of natural laminar flow that can be obtained with promising consistency on a subsonic cruise airfoil designed for favorable pressure gradients

W81-70162 **534-03-13**
Langley Research Center Hampton Va
COMPOSITE COMPONENTS TECHNOLOGY
H L Bohon 804-827-3081

The objective of the composite components program is to accelerate the introduction of composite structures in commercial transport aircraft This will be accomplished through the progressive introduction of selected components in current aircraft production Design technology for typical secondary structure components and medium sized primary structures will be developed Manufacturing processes suitable for production will be developed and verified through comprehensive ground testing Several articles manufactured will be placed in flight service for subsequent long term evaluation

W81-70163 **534-03-33**
Langley Research Center Hampton Va
LARGE COMPOSITE PRIMARY AIRCRAFT STRUCTURES (LCPAS) - KEY TECHNOLOGY
H L Bohon 804-827-3081
(534-03-13)

The composite Primary Aircraft Structures (CPAS) program is intended to provide the technology experience and confidence so that commercial transport manufacturers can commit to production of composite structures in their future aircraft The ongoing CPAS program has been highly successful in accelerating composites application in lightly loaded secondary structures of current and new commercial aircraft In this new related program major emphasis will be placed on long lead key technology issues critical to the eventual application of composites to primary wing and fuselage structures Contracts will be initiated with the major airframe manufacturers to develop and demonstrate satisfactory resolutions to specific preselected technology issues These resolutions will provide the thrust for a major Larger Composite Primary Aircraft Structures Technology program

W81-70164 **534-04-13**
Langley Research Center Hampton Va
TERMINAL CONFIGURED VEHICLE PROGRAM
James E Stitt 804-827-3745
(505-07-31)

The Terminal Configured Vehicle (TCV) Program is an advanced technology development activity focused on Conventional Takeoff and Landing (CTOL) Transport Aircraft that will need to operate effectively in reduced weather minima in the future high-density airspace environment using the new navigation aids surveillance and landing systems and traffic management procedures under development by the DOT/FAA The broad objective of the program is to develop and evaluate advanced flight management concepts procedures and avionic systems which when applied to commercial aircraft could improve airport and airway capacity aircraft efficiency and air crew effectiveness The activity involves research analysis mission simulations and flight studies using extensive facilities located at Langley Wallops Island FAA/NAFEC and FAA-designated controlled airspace A modified B-737 airplane equipped with highly flexible display and control systems is being used to study and exploit the full operating potential of advanced ATC systems in simulated future terminal area environments These studies will be performed with active participation by major airframe manufacturers and in cooperation with the DOT/FAA and DOD and representatives of major airlines

W81-70165 **534-04-18**
Wallops Flight Center Wallops Island Va
WALLOPS FLIGHT CENTER RESEARCH AIRPORT SUPPORT
Donald L Feller 804-824-3411

This RTOP covers the FY-81 program support costs associated with OAST programs that use the facilities of the Wallops Flight Center research airport and other supporting services Included are ADP operations SAR chase and other aircraft flight services crash fire and rescue services control tower management of Wallops Flight Center control zone program aircraft ground servicing shop support specialized instrumentation and miscellaneous equipment

W81-70166 **534-05-17**
Lyndon B Johnson Space Center Houston Tex
FIRE SYSTEMS FULL-SCALE TEST
D E Supkis 713-483-3211
(505-44-27)

The efforts defined in this RTOP consists of work originated in FY-75 The RTOP provides for the procurement of manpower for testing aircraft seats fabricated with newly-developed materials in the JSC 737 fuselage preparing the 737 fuselage and fitting it with instrumentation for conducting full-scale flammability tests computer support and evaluation analysis and delivery of technical data and reports

Advanced Propulsion Systems Technology

W81-70167 **535-01-12**
Lewis Research Center Cleveland Ohio
ENERGY EFFICIENT ENGINE PROJECT
Neal T Saunders 216-433-5594
(511-54-01 510-53-01 505-04-02)

The objective of the Energy Efficient Engine project is to develop and demonstrate technology for a next-generation turbofan engine having 10 to 15% lower specific fuel consumption at least a 50% reduction in rate of performance deterioration at least 5% reduction in direct operating cost and reduced emissions and noise levels as compared to current high-bypass turbofan aircraft engines Initial program efforts included preliminary engine design and integration studies through contracts with two major aircraft engine manufacturers On the basis of these studies and associated airframer and airline evaluations engine cycles and configurations that best meet project goals were identified The major part of the project was then initiated with award of parallel component development and integration contracts to the same two engine companies These latter contracts emphasize the advancements in component and systems technologies required for possible future commercial development of more energy efficient engines Advanced engine components are being designed and developed and performance will be verified by rig tests The high-spool core system will be designed fabricated and tested to evaluate its performance characteristics and to further refine the design of the components The low-spool assembly will be integrated with the core to evaluate two-spool integrated performance and mechanical systems performance

W81-70168 **535-02-12**
Lewis Research Center Cleveland Ohio
VARIABLE CYCLE ENGINE TECHNOLOGY
Albert G Powers 216-433-4000
(533-01-32 533-01-62)

This program will develop the critical low-spool component technologies unique to variable cycle engines for future advanced supersonic cruise aircraft Component and system performance and environmental characteristics will be demonstrated and evaluated both statically and in a simulated low-speed flight environment This program will build upon the results of the VCE Component Program and will provide validation of much of the low-spool technology It will continue to emphasize acoustic technology and a major milestone in the program will be a large scale jet noise test at simulated flight conditions in the NASA Ames 40 x 80 Foot Wind Tunnel This program will expand the development and evaluation of the Variable Stream Control Engine (VSCE) and the Double Bypass Engine (DBE) through contracted efforts Specifically the program will broaden the nozzle aero/acoustic performance data base over a wide range of aircraft flight conditions through a series of model nozzle tests Emphasis will be on coannular nozzle systems including mechanical suppressors thermal shields etc to meet FAR 36 stage 3 noise goals Critical low-spool components will be developed through component rig tests and will then be integrated into engine system demonstrations to verify their performance and environmental characteristics System testing including noise measurements in a low-speed simulated flight environment will be accomplished to verify at large scale that the coannular noise benefit is maintained in a forward velocity field

W81-70169 **535-03-12**
Lewis Research Center Cleveland Ohio
ADVANCED TURBOPROP PROGRAM
James F Dugan 216-433-4000
(535-03-11 535-03-13 535-03-14 530-05-12)

The objective of the Advanced Turboprop Program is to develop technology for efficient reliable and acceptable operation of advanced turboprop powered aircraft at cruise conditions comparable to those of current turbofan powered aircraft The Advanced Turboprop Program will be implemented in three phases In Phase I (funded in FY1978 thru 1980) a fundamental data base on small scale models was developed and the feasibility of the high-speed (Mach 0 7 to 0 8) turboprop concept was established This RTOP primarily covers Phase II of the program In Phase II the principal objective is to establish the fabrication and structural integrity of large scale high-speed propellers of advanced aero-acoustic design Large-scale propeller technology for diameters of 8 feet or greater will be developed Static low speed and high-speed flutter and excitation tests will be made for the experimental propeller system using a modified gas turbine drive While the primary emphasis in Phase II will be on the structural integrity of large-scale high-speed propellers there will also be work in other technology areas Conceptual engine design and preliminary designs of advanced gearboxes and pitch change systems will be evaluated The development of fuselage acoustic technology will continue with tests and upgrading of analytical tools Also further aerodynamic tests and analyses of turboprop aircraft model configurations will be conducted

W81-70170 **535-03-13**
Langley Research Center Hampton Va
ADVANCED TURBOPROP--INTERIOR NOISE
D G Stephens 804-827-3561
(505-33-53)

The objective of this program is to demonstrate technology readiness in the area of acoustics and noise reduction for advanced turboprop aircraft development Configurations of interest are aircraft powered by highly loaded multibladed turboprops for efficient high-speed operation Program emphasis is on propeller noise and fuselage attenuation technology The approach consists of the development of improved analytical and experimental methods for predicting propfan noise both in the near field and the far field and for predicting the transmission of noise through the cabin sidewall These prediction methods are being developed and validated by means of model tests during the Enabling Technology phase (I) of the program The improved prediction methods will be used to guide the design of low-weight high-attenuation sidewalls for passenger acceptance and the design of propfans for acceptable fuselage as well as community noise exposure The sidewall and propeller configurations resulting from acoustic considerations will be validated by small-scale and large-scale testing in Phase II of the ATP program and by flight tests during phase III of the program

W81-70171 **535-03-14**
Hugh L Dryden Flight Research Center Edwards Calif
ADVANCED TURBOPROP - FLIGHT RESEARCH
R S Baron 805-258-3111
(535-03-01 535-03-12 535-03-13)

The objective is to develop and demonstrate by flight research the technology for advanced turboprop propulsion systems having high propulsion efficiencies at cruise speeds and altitudes up to Mach 0 8 and 35 000 feet This technology could provide fuel savings of 15 to 20 percent relative to advanced high-bypass turbofan engines while meeting reliability requirements and environments noise constraints Two-foot diameter scale models of advanced high tip speed propellers will be installed on a JetStar aircraft capable of flying Mach 0 8 at 30 000 feet altitude Microphones will be placed on wing and fuselage and acoustic flight research will be performed to obtain near field noise data A study will be conducted of the B 52 as a test bed for large-scale turboprop testing examining in depth the options for mounting the attainable data and the related costs

Numerical Aerodynamic Simulator

W81-70172 **536-01-11**
Ames Research Center Moffett Field Calif
NUMERICAL AERODYNAMIC SIMULATOR (NAS PROJECT)
M S Johnson 415-965-6479

The primary objective of the NAS Project is to design and develop a unique large scale high performance computational resource for solving viscous three dimensional fluid flow equations specially oriented toward the solution of aerodynamic or fluid dynamic problems A secondary objective is to generalize the computational resource for application to a broader scope of problems of interest to NASA

Space Research and Technology Base

Aerothermodynamics Research and Technology

W81-70173 **506-51-11**
Ames Research Center Moffett Field Calif
COMPUTATIONAL AND EXPERIMENTAL AEROTHERMODYNAMICS
J G Marvin 415-965-5390
(506-54-41)

The objective is to establish aerothermodynamic technology and configuration design concepts to improve vehicle safety reliability versatility and aerodynamic efficiency with maximum payload for earth-orbital missions and planetary exploration Advanced computational methods and computer codes will be developed for predicting vehicle flow fields and performance Turbulence models (used in these computer codes) will be developed from building block numerical and physical experiments New instrumentation techniques will be developed for the measurement of turbulence quantities in 3-dimensional flow fields

W81-70174 **506-51-13**
Langley Research Center Hampton Va
SPACE VEHICLE AEROTHERMODYNAMICS AND CONFIGURATION TECHNOLOGY
J P Arrington 804-827-3911

The objective of this study is to develop configuration design concepts and the associated aerothermodynamic technology data base which will allow the achievement of space transportation vehicles operational in the 1990s and beyond which offer significant improvement in operational efficiency economy and safety The intent is to study both analytically and experimentally configuration concepts utilizing technologies advanced beyond the base being established by the Space Shuttle Specific studies will be directed toward solution of the aerothermodynamic problems associated with these concepts in such areas as aerodynamic performance viscous-interaction and real-gas effects vortex interactions heat transfer basic configuration shaping and optimization Computational flow-field methods will be developed with emphasis on realistic configurations and techniques for integrated configuration design analysis and optimization will be developed and continuously improved Feasibility studies of the use of the Space Shuttle Orbiter to obtain fundamental aerothermodynamic data applicable to future vehicle design will be pursued Various perfect gas and real-gas facilities will be utilized in experimental investigations to provide design data over a broad range of parameters If there are unique or novel opportunities that arise we will shift funds and manpower to address these areas

W81-70175 **506-51-21**
Ames Research Center Moffett Field Calif
PLANETARY PROBE AEROTHERMODYNAMIC TECHNOLOGY
H K Larson 415-965-5369

This effort is directed at providing the aerothermodynamic technology base in high-speed aerothermodynamics required for the design development and verification of probes entering planetary atmospheres and to provide computational and experimental support in a timely manner for the specific development of planned and approved missions in accord with the following targets (1) to provide a complete understanding and prediction of the shock-layer and ablation product radiative gasdynamics for planetary entry vehicles (2) to provide coupled flow field ablation solutions for outer planet probes and (3) to support the aerodynamic development of planetary probe configurations and to provide the flight mechanics data in support of atmospheric reconstruction experiments The coupled nature of outer planet probe aerothermodynamics requires a highly integrated computational and experimental program The theoretical and experimental efforts in the area of shock-layer radiation must be coupled with similar efforts in ablation product radiation and absorption These efforts in turn must be coupled with research associated with shock layer flow which is highly blown by ablation products In addition the flight mechanics of the probe both static and dynamic are significantly affected by the ablation mass loss and shape change Finally all these theoretical efforts and experimental validations must provide the required aerothermodynamic input to outer planet probe development

W81-70176 **506-51-23**
Langley Research Center Hampton Va
PLANETARY PROBE TECHNOLOGY
J J Jones 804-827-3031
(506-51-13 506-51-33)

This work encompasses computational and experimental support for advanced mission planning for possible future planetary entry vehicles as well as direct support for approved missions The only presently approved probe mission is the Galileo Project to Jupiter The delay in planned launch date for Galileo leaves open the possibility that additional support will be required in FY-81 It is expected however that most of the work will address future missions such as Saturn and Titan Venus aerocapture and aeromaneuvering vehicles While the mission support is developmental in nature aimed toward specifying heat-shield requirements and aerodynamic performance for a given configuration the work for future missions is basic in nature--analyzing thermodynamic and transport properties of various gas mixtures and species developing computation techniques for viscous and noncontinuum regimes or techniques for flow-field computations over new configuration classes such as biconics Work is primarily in-house with contractual assistance in some areas If there are unique or novel opportunities that arise we will shift funds and manpower to address these areas

W81-70177 **506-51-31**
Ames Research Center Moffett Field Calif
OEX FLIGHT DATA ANALYSIS
H K Larson 415-965-5369
(506-63-05 506-63-06)

This effort is directed to provide the gasdynamic and aerothermodynamic technology base that is required to analyze the aerothermodynamic data of flight origin from Shuttle Shuttle launched entry research vehicles or engineering experiments on NASA atmospheric entry missions to improve aerothermodynamic design techniques for new vehicles and to enhance the aerothermodynamic efficiency of the Shuttle This will be accomplished by addressing the following targets (1) to compare data from infrared imagery of Shuttle (IRIS) and development flight instrumentation (DFI) with Shuttle design techniques and advanced flowfield computations (2) analysis of data on catalytic wall effects to compare with computations of reacting flows (3) analysis and correlation of tile gap heating data and (4) comparison of data from Shuttle infrared leeside temperature sensing (SILTS) with advanced leeside flow field computations

W81-70178 **506-51-33**
Langley Research Center Hampton Va
AERODYNAMIC/AEROTHERMODYNAMIC FLIGHT DATA ANALYSIS
J J Jones 804-827-3031
(506-51-14 506-51-23)

The objectives of this work are to carry out analyses of aerodynamic and aerothermodynamic flight data and to compare the results with pertinent ground test data and theoretical methods to assess the adequacy and accuracy of theory and the techniques used to extrapolate wind-tunnel data to flight conditions to define areas where improved methods facilities or additional flight data are needed in order to make reliable predictions of flight aerothermodynamic properties and to identify areas for significant improvements in future orbiter modifications Shuttle orbiter entry data will be analyzed beginning with the first orbital flight making use of such instrumentation data as are available on a given flight A best estimated trajectory will be computed and used in extracting coefficients Meteorologi-

cal data will be combined with the trajectory information to determine free-stream state Thermocouple and calorimeter data will be used to determine time-dependent heating-rate distributions If there are unique or novel opportunities that arise we will shift funds and manpower to address these areas

W81-70179 **506-51-34**
Hugh L Dryden Flight Research Center Edwards Calif
SPACE SHUTTLE AERODYNAMIC EXPERIMENTS
T G Ayers 805-258-3311

The objective of this RTOP is to investigate the use of Shuttle Entry Air Data System (SEADS) type flush mounted pressure orifice and auxiliary flush orifices for air data measurements at subsonic and transonic speeds It will also extend the applicability of currently available mathematical tools for determination of digital flight control system stability and control performance structural and atmospheric turbulence characteristics in the reentry environment where aerodynamic data are virtually nonexistent

Chemical Propulsion Research and Technology

W81-70180 **506-52-12**
Lewis Research Center Cleveland Ohio
LIQUID-CHEMICAL PROPULSION TECHNOLOGY
Richard J Priem 216-433-6225

The objectives are to provide the technology for improving performance and reusability of liquid rockets and to obtain an improved understanding of basic chemical and physical processes for advanced chemical propulsion systems The work is divided into three areas (1) general advanced research and technology analytical and experimental programs will be conducted to improve the understanding of combustion phenomena thrust chamber life advanced cooling techniques and improved design techniques for more reliable chambers (2) low thrust chemical propulsion system - studies will be conducted to define propulsion system requirements develop parametric performance and cooling information evaluate small pump technology requirements and analyze low gravity fluid system components crucial to overall vehicle performance and (3) high density hydrocarbon fuel-LOX engine programs will be conducted to improve engine performance thrust chamber cooling and engine service life with minimum servicing and maintenance and turbomachinery performance and life

W81-70181 **506-52-17**
Lyndon B Johnson Space Center Houston Tex
ADVANCED MANNED VEHICLE ONBOARD PROPULSION TECHNOLOGY
R W Polifka 713-483-5495

The objective of this effort is to identify viable propulsion system designs and propellant alternatives which could replace N2O4/MMH in a second generation Shuttle auxilary propulsion system or similar advanced spacecraft propulsion systems and to establish the technology base necessary to allow for future systems development Phase out of N2O4/MMH may become necessary due to handling health hazards high propellant cost and high corrosivity of these propellants The oxygen hydrocarbon propellant family provides the most attractive alternative Oxygen hydrocarbon type propellants will be characterized and system design and trade studies conducted Propellant and design selections will be made and critical component technology and technology issues will be identified Component technology will be developed and carried forward into assembly level test evaluation

W81-70182 **506-52-19**
Marshall Space Flight Center Huntsville Ala
ADVANCED REUSABLE MAIN ENGINE TECHNOLOGY
Robert J Richmond 205-453-3710

Oxygen/hydrocarbon and oxygen/hydrogen systems required for advanced high pressure engines for future booster vehicles and for advanced main propulsion engines for future orbit-to-orbit vehicles are being investigated Single-fuel and dual-fuel dual-throat engine concepts are being examined The activities described include engine power cycle synthesis parametric data generation, component performance prediction and evaluation injector/combustor design and fabrication combustor and turbine cooling investigation These efforts include data screening analyses design computer modeling hardware fabrication data evaluation and test

W81-70183 **506-52-25**
Jet Propulsion Laboratory Pasadena Calif
HIGH ENERGY CHEMICAL PROPULSION TECHNOLOGY FOR PLANETARY SPACECRAFT
Winston Gin 213-354-3575
(506-62-35 506-53-36)

This RTOP supports the PASO specific objective of providing technology for advanced propulsion onboard planetary spacecraft including both chemical liquid and solid propellant systems This effort will provide the technology base for the highest practical performance liquid propellant propulsion system - a pump-fed space-storable system using liquid fluorine The general approach will utilize both analysis and experimental techniques which include engine testing Specifically the approach is to develop a small pump which is compatible with fluorine but will be characterized first with an earth-storable engine and subsequently with a space storable liquid fluorine-hydrazine engine Research which supports this technology will be done in materials compatibility especially in long term exposure to fluorine and in the nature and effects of nozzle vacuum exhaust plume dynamics of fluorine-hydrazine combustion products The target for completion of the all-up system test (technology readiness) of a pump-fed fluorine-hydrazine system with a high-pressure engine is FY-87 The objective is to add to the technology base of a solid propulsion system which incorporates an energetic nitramine oxidizer HMX The approach will involve a combination of study and experimenation including complete motor testing Experimentation specifically involves processability ballistics aging stability thermal stability and combustion stability of the next generation of Shuttle IUS and spacecraft injection stage propellants which use HMX nitramine oxidizers A special activity will be the completion of the heat-sterilizable solid propellant motor program in FY-81 The target for the completion of the energetic solid propellant work is FY-85 when it may be expected that HMX will be incorporated in the Shuttle IUS

W81-70184 **506-52-30**
National Aeronautics and Space Administration Washington D C
CHEMICAL PROPULSION RESEARCH SUPPORT
F Stephenson 202-755-3274

The objective of this task is to maintain up-to-date information gathering capability on the nation s total chemical propulsion technology effort which is of great benefit in planning and directing the NASA-wide effort The approach will be to share support of the Chemical Propulsion Information Agency (CPIA) which supplies this service with the DOD agencies through the Joint Army Navy NASA Air Force (JANNAF) Interagency Propulsion Committee

W81-70185 **506-52-35**
Jet Propulsion Laboratory Pasadena Calif
ADVANCED CHEMICAL PROPULSION CONCEPTS FOR PLANETARY SPACECRAFT
Winston Gin 213-354-3575
(506-52-23 506-62-35)

This RTOP supports the PASO specific objective of exploring new chemical propulsion concepts that promise significant increases in performance over conventional chemical rocket propulsion This effort will identify and then develop new concepts to provide ultra-high performance chemical rocket propulsion with specific impulse in the 600-800s range at moderately low thrust levels The costs involved with long duration missions to the outer planets where high escape velocities and thus high specific impulse propulsion are required must be decreased These missions can be supported by electric propulsion However

because of the very low thrust of electric propulsion systems flight times which translate into long mission support times and costs are very long, so that a higher thrust system without a great mass fraction or specific impulse penalty is needed The approach is to evaluate advanced propulsion concepts such as *metastable compounds free radicals electrical augmentation* select promising concepts and get bench level and breadboard experimental results in both specific impulse and mass fraction This work will demonstrate techniques which will produce propellants using resources natural to selected exterrestrial bodies The justification for studying the manufacture of propellants at the planets and their satellites is to reduce the consumables which must be carried from Earth Enabling missions can result which use in-situ manufactured propellant for planetary take-off return to earth or refueling stations The approach for extraterrestrial propellants is laboratory demonstration of production of oxygen and methane from Martian CO2 and H2O and mission studies of propellant production at satellites of the outer planets The target for completion of the laboratory demonstration for oxygen production is the end of FY-83

W81-70186 **506-52-39**
Marshall Space Flight Center Huntsville Ala
PLUME CHARACTERIZATION
R J Richmond 205-453-3710

A chapter dealing with plume contamination effects for the JANNAF Plume Technology Handbook and a low altitude rocket plume flow field prediction computer program are being developed Existing computer programs and experimental data dealing with all areas of plume technology are being reviewed and documented in a JANNAF Plume Technology Handbook The present year s effort is directed at preparing the chapter on plume contamination effects A streamlined low altitude rocket plume flow field computer program or set of programs will be developed by combining the best features of the existing programs into one new program

Materials and Structures Research and Technology

W81-70187 **506-53-10**
National Aeronautics and Space Administration Washington D C
SPACE ENGINEERING
Michael A Greenfield 202-755-2364

The objective of this RTOP is to provide a fundamental research program to obtain an understanding of the effective use of space vehicles and exploration of space The program will concern itself with novel structural forms humam productivity in space and maintenance of the geometric tolerances of large space structures It will employ both graduate research assistants and undergraduates utilize independent studies as an opportunity to develop the necessary skills of a qualified space engineer and will help fund the experimental projects laboratory at MIT

W81-70188 **506-53-11**
Ames Research Center Moffett Field Calif
SURFACE PHYSICS AND COMPUTATIONAL CHEMISTRY
J O Arnold 415-965-6209

The objective is to develop a detailed understanding of the mechanisms which control important properties of matter and how they are modified by a wide range of environments This understanding is leading to the development of new materials and processes needed by the agency Properties of metallic interfaces are being determined by probing their structure at the atomic level Knowledge of surface/environment interactions is being improved by studying gaseous surface reactions and how they relate to microscopic materials properties Work is underway on feasibility studies for mapping hydrogen concentrations on metal surfaces The atomistic structure and properties of epitaxially absorbed layers of metallic and semiconducting materials on well defined substrates is being investigated The physical and chemical properties of molecules and small atomic clusters (5-14 atoms) are being calculated using state-of-the-art wavefunction computer codes These quantum mechanical results for the small clusters which represent small bits of material are extrapolated by classical mechanics to determine surface and bulk properties of materials Improvements in precision code *optimization and approximate methods are allowing larger systems* to be studied and thus requiring smaller extrapolations to obtain surface and bulk properties This also helps to elucidate the manner in which properties of atomic clusters approach those of the bulk material These calculations are currently being used to investigate chemisorption diffusion corrosion hydrogen-induced crack growth and the properties of catalytic particles

W81-70189 **506-53-12**
Lewis Research Center Cleveland Ohio
MATERIALS SCIENCE
S J Grisaffe 216-433-4000

The objectives are to develop greater understanding of materials with aerospace propulsion and power potential and to thereby develop guidelines for improving their physical and mechanical properties Fundamental materials studies are aimed primarily at determining the mechanisms limiting material performance and useful material life as well as at identifying scientific concepts which might be applied to substantially improve such materials The focus includes studies of the compositional influence on toughness of intermetallic aluminides and on thermal fatigue resistance of superalloys metallic composite and fiber strengthening ion exchange chemistry of battery separator membranes the basics of friction wear and adhestion the chemistry and morphology of solid and liquid lubricants and the fatigue behavior of potential bearing and gear materials

W81-70190 **506-53-15**
Jet Propulsion Laboratory Pasadena Calif
FUNDAMENTALS OF MECHANICAL BEHAVIOR OF COMPOSITES MATRICES
J Moacanin 213-354-3178

The long-term objective seeks to develop a fundamental understanding at the molecular level of organic matrix composites used in current and planned space and primary airframe structures Applications for this research are aimed at the evaluation of long-term performance of advanced composites as well as of the adhesively bonded interfaces and will support advanced space power and transportation systems and large space structures From correlations of molecular parameters with observed mechanical properties and failure mechanisms of composite materials strategies will be developed for seeking molecular structures and composite systems which would exhibit higher performance longer life and lower cost Although the reinforcing fiber controls strength it is the matrix that plays a dominant role in the control of fatigue life because failure occurs either in the matrix or at the matrix-fiber interface In FY81 the focus will be on the development of the understanding of molecular dynamics of processes that control matrix behavior Aspects of the macroscopic description of behavior will be continued The approach includes determination of the time-temperature dependence of engineering properties (e g Poisson s ratio and creep compliance) as function of chemical composition morphology process history and physical and environmental aging Fundamental aspects of chemical degradation processes will be investigated using electron spin resonance (E S R), spectroscopy and related techniques to identify and characterize transient *species induced by thermomechanical stresses*

W81-70191 **506-53-17**
Lyndon B Johnson Space Center Houston Tex
REFINING OF NONTERRESTRIAL MATERIALS
R J Williams 713-483-2781

These studies are designed to provide data on chemical and physical processes which might be used to extract silicon and glasses from lunar rocks and soils for ultimate use in constructing and supporting space projects Laboratory experimentation will be used to measure the physical and chemical characteristics and the efficiencies of processes which can extract useful materials from lunar rocks and soils The research will be confined to laboratory study at the bench-top scale and will

concentrate on measurement of basic physics and chemistry involved Three areas of study will be the recovery of silicon from rocks and minerals using hydrofluoric acid leaching separation of anorthite from soils and recovery of oxygen from carbonaceous gases by electrolysis Making of foamed glasses and glass composites using oxygen will be a fourth area for later study All studies will be pursued by studying the output of a process as successively more complex starting materials are used

W81-70192 **506-53-23**
Langley Research Center Hampton Va
COMPOSITES FOR ADVANCED SPACE SYSTEMS
D R Tenney 804-827-2434
(533-01-13 505-33-33 506-62-43)

The objective of this research is to develop durable composites for long-life service in future space systems and advanced space transportation systems To determine the space durability of advanced resin matrix composites electron and proton radiation exposures will be conducted using appropriately equipped laboratories to simulate the natural space environment Theoretical models will be developed to predict the effects of space exposure on structural composites and will be verified with experimental data Radiation damage mechanisms will be identified to guide new materials development For higher temperature applications graphite/polyimide and metal-matrix composites such as SiC/Ti Gr/Mg Gr/Al will be developed and subjected to thermal environmental and mechanical cycles Fabrication procedures will be established for each system developed and preliminary design allowable data generated To determine the response of composites to cyclic loading a generic fatigue methodology will be developed wherein only data from simple laminates or lamina are needed to evaluate material constants and the changes in the constants under repeated fatigue loads Basic studies of molecular properties will be investigated to better charactierize defects in materials

W81-70193 **506-53-25**
Jet Propulsion Laboratory Pasadena Calif
EFFECTS OF SPACE ENVIRONMENT ON COMPOSITES
J Moacanin 213-354-3178

The long-range objective is to develop ultrafast pulse radiolysis as a tool for the determination of primary degradation processes caused by charged particles and to ultimately use this information along with conventional high energy exposure material test data to develop a reliable methodology for estimation of the long-term effects of the space environment on polymers and composites The objective in FY-81 is to initiate development and validation of a predictive model of degradation for candidate materials such as epoxies polyimides and polysulfones Pulse radiolysis transient measurements will be used to determine rates of fast processes such as dissociation of a molecular ion generation of an excited state from ion recombination or homolysis of an excited state generating a radical pair Pulse radiolysis utilizing a pulsed electron beam and fast optical and ESR detection assemblies can monitor these types of fast processes and measure their rates These data along with steady-state data will be used to develop analytical models of degradation and a reliable prediction technology for 20-year lifetime applications

W81-70194 **506-53-29**
Marshall Space Flight Center Huntsville Ala
LONG-TERM SPACE ENVIRONMENTAL EFFECTS ON MATERIALS
R L Gause 205-453-1500
(910-38-20 506-16-22 506-16-25)

The objective is to evaluate the long-term effects of the space environment on candidate materials for future long-duration space programs The approach will be to assess future long-term programs to define potential materials requirements from design definition and mission environment profiles Candidate materials will be selected for evaluation An environmental test matrix will be developed for these candidate materials from the materials requirements An appropriate test program will be performed to acquire the required data A Space Materials Design Guide will be developed

W81-70195 **506-53-31**
Ames Research Center Moffett Field Calif
THERMAL PROTECTION SYSTEMS MATERIALS AND SYSTEMS EVALUATION
H K Larson 415-965-5369
(506-51-21 506-63-06)

The objective is to provide thermal protection systems concepts and materials for heat shields to protect earth and planetary entry vehicles and planetary probes during atmospheric entry The specific objectives are to (1) develop improved fiber materials and minimum weight TPS to enhance the Space Shuttle and enable fully reusable advanced space transportation systems development (2) develop planetary probe heat shield materials and determine methods to minimize heat shield weights (3) develop concepts and heat shield materials for safe earth entry of radioactive power sources and to support DoD requirements The system requirements for each end use are defined Thermal protection materials parameters are determined that meet these requirements Materials are either selected from the extensive technology in existence or new materials with optimized properties are developed Candidate thermal protection concepts and materials are subjected to systematic analysis and testing to qualify them for the defined end use Extensive unique Ames arc plasma test facilities developed for Space Shuttle and planetary entry probes are used in the experimental evaluations Analytical studies are performed utilizing unique environmental computer codes developed by ARC that include detailed models of both the aerothermal environment and material response to obtain in-depth understanding of the material characteristics Detailed temperature dependent radiation properties are computed for gaseous species required for thermal response analysis Materials are often developed as a result of these studies to meet the ever more stringent requirements for atmospheric entry thermal protection

W81-70196 **506-53-33**
Langley Research Center Hampton Va
THERMAL PROTECTION SYSTEMS FOR EARTH-TO-ORBIT STS
S C Dixon 804-827-3423
(505-53-73 506-53-63 506-53-33)

The objectives of this research are to provide heat shield testing to support the space shuttle program and to develop improved thermal protection system materials and concepts for advanced space transportation systems Available arc-tunnel and other facilities will be used as required to validate the Space Shuttle TPS If problems are discovered in the course of this testing in-house programs will be undertaken to find solutions Environmental exposure testing of RSI will continue For advanced vehicles new materials and concepts will be developed with emphasis on metallic materials Emittance of high temperature alloys after exposure to flowing air will be determined The possibility of increasing this emittance will be explored High temperature creep will be studied data will be generated on various alloys and a design methodology will be developed based on statistical analysis of the data A model for cyclic creep will be developed Thermomechanical processing techniques which improve creep resistance and other properties of materials will be evaluated The possibility of developing a high performance carbon-carbon heat shield material will be explored Metallic TPS concepts will be evaluated via tests in the 8-Foot High Temperature Structures Tunnel and the Thermal Protection System Test Facility

W81-70197 **506-53-37**
Lyndon B Johnson Space Center Houston Tex
ADVANCED CARBON-CARBON STAND-OFF PANEL
D M Curry 713-483-2376

This RTOP provides for the procurement of a design fabrication and test of a carbon-carbon stand-off panel using the advanced carbon-carbon material being developed by The Vought Corporation under a NASA Langley contract Fabrication and testing of prototype hardware will accelerate carbon-carbon panel design concepts to obtain test data and to demonstrate weight and cost control

W81-70198 **506-53-39**
Marshall Space Flight Center Huntsville Ala
THERMAL CONTROL SYSTEM TECHNOLOGY
J L Vaniman 205-453-1171

Space vehicles envisioned during the operational phase of the Space Transportation System (STS) will require thermal control in magnitudes and configurations beyond the capability of current technology Development of new system concepts as well as new components will be required in a timely fashion to meet the needs of these vehicles The purpose of the tasks described in this research and technology effort is first to develop components which will be vital to future thermal control systems (TCS) Upon completion of component design fabrication and testing TCS elements will be integrated at the breadboard level to evaluate system performance and life characteristics Finally where appropriate flight experiments will be developed to gather data and prove designs and concepts before incorporation into operational vehicles Technology items and tasks will be grouped into several areas of concern Thermal control surfaces will be developed to provide adequate performance for extended lifetimes Components will be developed in the area of fluid and thermal interfaces to insure against leakage across rotating joints and to demonstrate necessary performance at high total heat loads and high watt densities Heat pipe developments will be pursued in the areas of cryogenic thermal control of scientific instruments and improved radiator reliability for extended orbital lifetimes

W81-70199 **506-53-43**
Langley Research Center Hampton Va
ADVANCED SPACE STRUCTURES
M F Card 804-827-3054
(506-62-43)

Research will be conducted on advanced structural concepts for future large space systems Efforts will include the development of generic spacecraft building blocks advanced analysis and design techniques and preliminary planning of possible flight experiments Concepts for producing very high density packaging in deployable structures will be investigated Analysis and design efforts on structural sizing of generic platform and antenna studies will be continued with emphasis on very slender member effects Experiments to identify critical problems in assembly of erectable structures will continue Reassessments of dynamic instrumentation and test requirements for the SEPS experiment will be conducted Work under this RTOP will be coordinated with more focused research under the Spacecraft Systems R and T Program

W81-70200 **506-53-53**
Langley Research Center Hampton Va
FAILURE AND THERMAL ANALYSIS
M M Mikulas 804-827-2551

Advanced structural analyses and design methods will be provided to predict accurately and economically the deformations stresses collapse and damage tolerance of future space structures Theoretical analyses and design efforts include research on new equations to represent structural behavior and the development of algorithms to improve the efficiency of computational methods Analyses will be developed to reflect and predict the failure modes observed in tests of damage tolerant composite structures Emphasis will be on developing analyses to predict quantitatively the behavior of structures subjected to high static loads cyclic loads thermally-induced stresses and impact damage Selected structures fabricated from several advanced material systems will be tested to evaluate the accuracy of the advanced analyses

W81-70201 **506-53-55**
Jet Propulsion Laboratory Pasadena Calif
OPTIMIZATION OF STRUCTURAL SYSTEMS
J A Garba 213-354-2085

The principal objective is to develop optimization methods and analytical tools for the efficient design of structural systems The long range objectives are to develop optimization techniques considering interdisciplinary interactions in structural synthesis and to advance the state-of-the-art of optimization The initial efforts will be centered around an existing state-of-the-art structural synthesis program ACCESS-3 The computer program will be expanded to include capabilities which are essential to the efficient analysis and synthesis of aerospace structural systems The activities will be collaborated with Prof L A Schmit of UCLA as consultant to the program and will be coordinated with personnel at LaRC who are conducting related work

W81-70202 **506-53-63**
Langley Research Center Hampton Va
LOADS, DYNAMICS AND AEROELASTICITY
M F Card 804-827-3054

The objective of this effort is to develop and validate analysis and test methods for the prediction and verification of structural response and stability in dynamic and thermal environments for use in the support of design optimization and qualification of space transportation systems and payloads Work on structural dynamics is directed to the improvement of test techniques for large space structures and investigations of methods of providing active damping for such structures Improved instrumentation and software to measure low-frequency response and to perform on-line dynamic data analysis will be developed Complementary work in large space structures will be conducted on theoretical techniques for adaptive control and controller design In work on aerothermal loads heating and pressure effects on space transportation system structures will be investigated Effects of surface variation coves wing/body and wing/elevon junctions will be studied in wind tunnel tests

W81-70203 **506-53-64**
Hugh L Dryden Flight Research Center Edwards Calif
LOADS, DYNAMICS, AND AEROELASTICITY
R A Fields 805-258-3311

Experimental data from laboratory tests of existing high temperature structures will be obtained and used to evaluate available computer analysis methods for prediction of temperatures deflections and strains These correlations will also be used to improve parametric information to aid future designs It is anticipated that additional specimens will also be tested in this program as they become available from development programs at the Langley Research Center Airloads obtained from calibrated strain gages on OV 101 and 102 will be compared with wind tunnel and theoretical predictions to evaluate flight measurement technique and analytical methods

W81-70204 **506-53-65**
Jet Propulsion Laboratory Pasadena Calif
SPACE VEHICLE DYNAMICS METHODOLOGY
J A Garba 213-354-2085

The principal objective of this five-year effort is to perform research and advanced development in dynamics criteria design analysis and testing to develop and update analysis and test methods Basic research will be performed in structural dynamics related to future problems such as large complex nonlinear space structures These methods will be used for the prediction and verification of structural response and stability in support of advanced design optimization and qualification of space transportation systems and payloads The activities will be coordinated with NASA headquarters other NASA centers and the Dynamic Acoustic and Thermal Environment (DATE) Working Group chaired by GSFC The task will utilize existing data from flight programs (Viking Voyager and others) until the Shuttle Orbiter bay flight data are avialable It is presently planned to support a Resident Research Associate during this fiscal year

W81-70205 **506-53-66**
Goddard Space Flight Center Greenbelt Md
PAYLOAD ENVIRONMENTS AND DYNAMICS
J P Young 301-344-8284
(506-63-36)

The overall objectives are to produce improved means for generating vibroacoustic environmental design and test specifications for STS payload components and to produce improved techniques for structural analysis of STS payloads Specific objectives are to exercise and validate use of the VAPEPS computer program designed for efficient prediction of STS payload component random vibration environment to validate the PACES

program designed to predict STS payload bay acoustic environment to obtain/evaluate STS payload flight data that is specifically suited for providing verification of payload design loads and environmental prediction methods and to produce an improved technique for static and dynamic analysis of structures composed of many repeated identical modules The approach is to input early STS payload flight data into the VAPEPS program and make component random vibration environment prediction for most immediate following flights to correlate measured flight acoustic data with PACES program predictions to serve as the Principal Investigator for the LDEF/SBEM acoustic environment measurement experiment via the DATE Working Group activity plan and manage the acquisition processing and utilization of STS payload flight data to evaluate the relative importance of random vibration induced loads with respect to liftoff low frequency transient induced loads and to develop a technique for reducing computer secondary storage requirements for analysis of structures composed of many repeated modules

W81-70206 **506-53-69**
Marshall Space Flight Center Huntsville Ala
SPACE VEHICLE DYNAMICS
R S Ryan 205-453-2481

The objective is to continue the development of techniques for predicting the dynamic response of space transportation systems and payloads Several tasks will contribute to the accomplishment of this objective A continuing task will be to update the vibroacoustic reference data banks with Space Shuttle/payload flight and test response data and to enhance computerized data storage/retrieval capabilities Vibroacoustic prediction techniques that combine classical model approach finite element modeling and component mode synthesis will be developed A unified approach to predicting acoustic environments for both engine-generated and aerodynamically generated noise will be developed Methods of analyzing complex structures and providing dynamics data to users will be developed The method developed will provide the accuracy and efficiency required to generate design data within cost and time constraints An optimized short cut methodology for payload loads assessment will be developed and validated The methodology will key levels of analytical resolution to the state of payload development i e preliminary loads intermediate loads or final loads cycle The following major tasks are being undertaken to accomplish the objective (1) development of Shuttle/payloads structural vibroacoustic data bank development of (2) improved structural and fluid dynamic analysis capability, and development of (3) acoustic environmental accuracy requirements for response determination and development of payload loads

Electronics and Automation Research and Technology

W81-70207 **506-54-41**
Ames Research Center Moffett Field Calif
PHOTOPHYSICS AND LASER DIAGNOSTICS
R L McKenzie 415-965-6158
(506-51-11)

The objective is to incorporate modern laser technology and photophysics in a program to develop photodiagnostic techniques for the characterization of gaseous media in a dynamic state In most cases the gas will be flowing and may also be dynamically unsteady and thermally or chemically out of equilibrium In the near-term primary emphasis continues to be placed on the measurement of turbulent fluctuations in the state variables of cold transonic and supersonic wind tunnel flows For the longer term a secondary activity involves the spectroscopy of small molecules and their quantitative detection in concentrations as low as parts per billion Primary experimental techniques are those unique to laser spectroscopy Initial applications will be on important species common to combustion processes and to the fluorocarbon chemistry of the stratosphere

W81-70208 **506-54-42**
Lewis Research Center Cleveland Ohio
ELECTROPHYSICS
R E Alexovich 216-433-6689
(506-61-22 541-02-12 650-60-22)

The objective of this RTOP is to develop technology concepts and components for improving life reliability and performance of microwave electron beam and solid state amplifiers To pursue this objective research and technology development programs will be undertaken on various components of microwave amplifiers such as high current density thermionic and field emission type cathodes beam forming and confining devices and materials for solid state devices reliability

W81-70209 **506-54-43**
Langley Research Center Hampton Va
QUANTUM ELECTRONICS DEVICES AND SENSORS
S L Ocheltree 804-827-2791
(506-61-33)

The broad objective of this research is to discover investigate and develop new and novel electro-optic materials devices and sensors involving lasers modulators photodetectors, integrated optical circuits fiber optics and optical signal processing transfer and storage New ideas are selected on the basis of their potential to provide the substantial increases in lowered costs, higher performance and reliability needed to meet the agency s aerospace mission and research requirements in the late 1980 s and beyond Initial emphasis will be placed on methods of improving sources of coherent radiation needed in the 9 to 30 micrometer range for remote sensing of the Earth and planetary atmospheres and faint astronomical sources

W81-70210 **506-54-45**
Jet Propulsion Laboratory Pasadena Calif
QUANTUM ELECTRONICS SOURCES
E D Hinkley 213-354-6586

The purpose of the electrophysics project is to perform basic research studies of the interaction of electromagnetic radiation with matter develop new lasers for remote sensing applications perform fundamental measurements to demonstrate remote-sensing potential and develop analytical techniques associated with such measurements The following tasks are in support of these objectives (1) demonstrate the feasibility of a small laser operating in the submillimeter region for remote sensing of species (2) demonstrate feasibility of a diffraction radiation (DRG) free electron laser operating at submillimeter wavelengths (3) demonstrate narrow-linewidth operation of present laser and evaluate remote-sensing applications potential (4) study physical and chemical processes occurring in laser discharges with the objective of developing and improving UV/VIS gas lasers for active remote sensing applications (5) measure cross sections for electron-atom molecule and ion interaction pertinent to laser and plasma devices (6) modify existing infrared laser system to measure atmospheric backscatter coefficients to a range of 20 km from laboratory and improve pulse rate (7) develop and apply new mathematical methods for nonlinear systems applications involve solitons nonlinear and dispersive waves and (8) study unstable dispersive waves

W81-70211 **506-54-46**
Goddard Space Flight Center Greenbelt Md
MULTI-SPECTRAL DETECTORS AND SENSORS
H W Price 301-344-8988
(506-61-36 506-18-16)

This RTOP consists of three tasks The IR Heterodyne Spectroscopy task has as its objective the development of infrared heterodyne spectroscopy for exploration of non-thermal electromagnetic radiation lines at wavelengths greater than 15 microns An infrared photomixer laser local oscillator and spectral line receiver will be developed for this purpose The purpose of the Tunable Submillimeter Local Oscillators Research task is threefold (1) to improve the efficiency and power output of existing lasers using energy transfer and buffer gas techniques (approaches which utilize shifted CO2 laser frequencies to enhance pumping efficiency will also be explored) (2) to produce new SMMW lasers and pump lasers (these would include Resonant Transfer Lasers in

the 12-20 micron range flash pumped gas lasers and 5 GHz tunable solid state lasers) (3) to tune the present laser emissions using interacavity phonon scattering in quartz The Advanced Detector Research task has as its objective the development of advanced instruments and telescopes for use on Shuttle flights and new missions dedicated to observation and astronomical studies from both space and ground This objective will be accomplished through advances in detector technology to obtain high resolution and low noise from large format imaging systems which operate in spectral ranges extending from soft X-ray through the ultraviolet and visible into the far red

W81-70212 **506-54-55**
Jet Propulsion Laboratory Pasadena Calif
DATA TRANSMISSION AND PROCESSING RESEARCH
A R Johnston 213-354-4054

This RTOP consists of the following two areas Fiber optic data transmission research in which the goal is to advance the technology of devices critical to fiber optics data transmission and processing for future NASA mission applications The objectives are to develop a solid state picosecond pulse generator evaluate the stability of precise time distribution by optical fiber and to investigate optical fiber transmitter and receiver design for data rates higher than 1 Gbits/sec and advanced optical techniques for real-time data processing which completes a study and demonstration of new optical techniques for processing two-dimensional data such as synthetic aperture radar data to be used for spacecraft and aircraft remote sensing systems The most promising candidates for a system realizeable in the next 2-3 years are spatial light modulators There are two prime candidates for a two-dimensitonal spatial light modulator the liquid crystal light valve (LCLV) and the Pockels readout optical modulator (PROM) A study being conducted this summer (FY80) at USC will determine which device is the most promising That device will be chosen for the work to be performed under this RTOP Wherever 'spatial light modulator is mentioned in this RTOP there will be only one specific device actually being used

W81-70213 **506-54-56**
Goddard Space Flight Center, Greenbelt Md
SIGNAL DETECTION AND PROCESSING FILTERS AND RECEIVERS
J F Arens 301-344-5758

This RTOP consists of two areas (A) tunable Fabry-Perot filters (TFBF) and (B) integrated acousto-optic spectrometer (IAOS) research The intent of (A) is to develop a cryogenic TFBF with high finess enabling the development of astronomical observing instruments with high resolving power in the midinfrared wavelength region Several possible techniques for constructing these filters will be explored with special emphasis being given to a type of Fabry-Perot filter in which one plate of the interferometer levitates in a magnetic field generated by induced currents in a superconductor on the plate A part of this proposed research would be directed at extending thin film deposition technology for interference coatings beyond its present range limit of about 15 micrometers to 20 micrometers into the 25 micrometers to 50 micrometers region The objective of (B) is to develop wide bandwidth IAOS to be used as spectral line receivers in heterodyne spectrometers for space applications

W81-70214 **506-54-59**
Marshall Space Flight Center, Huntsville Ala
SIGNAL PROCESSING AND DETECTION HIGH-DENSITY CIRCUIT TECHNOLOGY
J M Gould 205-453-3772

This effort provides comprehensive means to reduce design and fabrication cycle time and cost for large and very large scale integrated (LSI & VLSI) circuits electronic subsystem packaging costs and screening and reliability testing costs Developments include two level metal (TLM) post processing for existing LST and developing VLSI technologies layout software for TLM semicustom devices with 10 to the 6th transistors per sq cm a TLM embodiment of the structured design approach as a 10 to the 7th transistors per chip full custom alternate design synthesis simulation test pattern generation and validation software driven by high level language evolving towards hierarchal design a low cost turn key design system color and VLSI interactive graphics a subsystem cost model to define cost effectiveness of custom integrated circuits methods to interface with VLSI vendors by participation in the development of a VLSI process in which TLM circuits are created epoxy lid sealing repair and multiwire packaging techniques applied to existing flight hardware multichip subassembly arrays procurement and application standards for plastic encapsulated integrated circuits procedures for wafer testing and optical scanning inspection criteria for improving the reliability of multilayer ceramic capacitors operating procedures for X-ray topographic inspection of wafers and corrective actions for failure causes in VMOS power transistors

W81-70215 **506-54-60**
National Aeronautics and Space Administration Washington D C
HIGH DENSITY CIRCUIT TECHNOLOGY ELECTRONIC DEVICES
Martin M Sokoloski 202-755-8503

The objective of this program is to provide effective coordination of NASA-sponsored research and development efforts on electronic devices and systems with similar work supported by DOD and other government agencies Through associate membership on the Advisory Group on Electron Devices and its constituent working groups NASA program managers receive expert advice on the feasibility currency and soundness of planned R&D procurement activities long ranging R&D requirements complementary work in other government agencies and forecasts of new technical developments

W81-70216 **506-54-63**
Langley Research Center Hampton Va
ADVANCED ELECTRONIC COMPONENTS
R L Stermer 804-827-3535
(506-20-23 506-18-13)

The objective is to develop advanced electronic devices and components for increased capability and cost efficiency of information handling Additionally novel device concepts are to be evaluated to enhance information acquisition in terrestrial observation and similar aerospace applications A balanced approach between research contracts grants and in-house research is used Theoretical and experimental investigations of materials and device concepts will be conducted in-house These studies provide a basis for a balanced contractual effort to develop those material and device technologies which have potential of improved performance and cost effective information handling

W81-70217 **506-54-65**
Jet Propulsion Laboratory Pasadena Calif
FUNDAMENTAL ELECTRONICS
J Maserjian 213-354-3801
(506-25-75 506-61-35)

This RTOP consists of two tasks (A) Physics and Chemistry of Reliability This task has as its objective research into cost-effective methods for overcoming major reliability problems limiting the implementation of large and very large scale integrated (LSI/VLSI) electronic circuits necessary for future space systems Such problems, in part are lack of long-life reliability susceptibility to radiation damage and lack of custom LSI/VLSI design capability The approach to the reliability question for field-effect devices lies in the physics and chemistry of interfaces the region between the semiconductor and the insulating layer which influences the device channel conductivity To this end electrical and interface/surface analytical techniques are developed to study various phenomena such as the correlations between chemical processing and device failure Results will provide a base for computer-automated diagnostics on test chips on industrial LSI circuit fabrication lines Custom LSI capabilities are being addressed by the development of a computer-based design system for use by all NASA Centers (B) Advanced Solid-State Devices This task has as its objective the development of advanced devices such as solid-state oscillators multispectral sensors detectors and mixers and superconducting devices for future space mission requirements The approach is based on

investigations of new materials techniques and device structures e g the synthesis of new compound semiconductor microstructures by means of advanced ultra-highvacuum techniques such as molecular-beam epitaxy (MBE) with associated surface-analysis techniques These efforts will impact advanced detector arrays submillimeter wave devices cryogenic semiconductor bolometers superconducting devices for improved far-IR spacetelescope detectors and improved pyroelectric broad-band IR detectors for long-term non-cryogenic operation

W81-70218 **506-54-69**
Marshall Space Flight Center Huntsville Ala
SOLID STATE RESEARCH SUPERCONDUCTING CIRCUITRY
P N Peters 205-453-5134
(188-41-54)

Existing facilities for thin film deposition microfabrication and cryogenic measurements are being utilized to investigate and develop sensors based on superconducting electronic properties These devices will be compatible with flight experiments requiring cryogenically cooled surfaces Single and arrayed Josephson junctions coupling techniques fundamental material properties superconducting quantum interference effects and sensor/photon interactions are being investigated and hybrid circuits operating at liquid helium temperatures are under consideration

W81-70219 **506-54-73**
Langley Research Center Hampton Va
AUTOMATED DECISION MAKING AND PROBLEM SOLVING
A J Meintel 804-827-2489
(506-54-83)

The objective of this research activity is to make available to NASA the complete range of generic automated problem solving techniques and advanced machine intelligence concepts The long-range goal is to fill the technology gaps and provide those machine intelligence advances needed to allow the design development and utilization of advanced systems required for automated operations consistent with NASA s needs both in space and on Earth The near term approach is to determine the state-of-the-art capability in automated decision making and to devise and institute mechanisms to make this capability available to appropriate areas within NASA and to institute grants and contracts that advance decision making technology The long-range approach is to modify and advance these decision making algorithms and techniques through in-house research grants and contracts as required to fulfill NASA s special needs The scope of the work will be expanded through a phased buildup to encompass a broad based machine intelligence research effort

W81-70220 **506-54-75**
Jet Propulsion Laboratory Pasadena Calif
AUTOMATION OF SPACE MISSION UPLINK PROCESS CONTROL
Terry D Linick 213-354-3161
(540-01-15 543-01-16 506-54-76 506-54-73)

The objective of this task is to identify and develop specific mechanisms for application to the uplink process control (often called sequencing) of space missions to significantly reduce its cost and to increase system responsiveness to user inputs The uplink process control for recent deep space missions has been noted for very high costs and the time required to transform a request for an observation into an onboard activity has become quite large Since a substantial part of the uplink process control has been manual-labor-intensive application of automation techniques has the potential for significant improvements with respect to cost and responsiveness The approach consists of (1) examining current uplink process control architecture to discover where automation would be useful (2) analyzing appropriate automation technologies and (3) synthesizing the results of items (1) and (2) to determine where and how to automate uplink process control The conclusions will address how automation can be immediately applied to uplink process control which technologies will have such applications in the future and will recommend the directions for development of critical technologies which would make them more useful to uplink process control The conclusions will address how automation can be immediately applied to uplink process control which technologies will have such applications in the future and will recommend the directions for development of critical technologies which would make them more useful to uplink process control This RTOP was initiated as a result of developments in artificial intelligence at JPL and the continued development and application of artificial intelligence is considered a key ingredient in this task Thus research into the ERIS technology previously covered by RTOP 506-19-35 (Robotics/Machine Intelligence) is continued The study is oriented toward providing tangible benefits as rapidly as practical While continuing to develop and identify base technologies The refore the recommendation for near-term incorporation of automation techniques is scheduled for delivery in the third quarter of 1981 Recommendation for future directions for technology development will be completed by the end of FY-82

W81-70221 **506-54-76**
Goddard Space Flight Center Greenbelt Md
AUTONOMOUS PROCESS CONTROL TECHNOLOGY FOR EARTH ORBITAL MISSIONS
J L Maury 301-344-6683
(506-20-16 520-73-06 541-01-16)

This RTOP will provide and validate the advanced software/hardware tools and algorithms required for a dynamic automatic scheduling system (DASS) The scheduling of ground support services for Earth-orbital spacecraft currently relies on a labor-intensive primarily manual approach based on real-time priority assignments with relatively little optimizing capability and no direct knowledge of the load it imparts on the total processing system The DASS as it is conceived will make more efficient use of this spacecraft support system and markedly decrease the work force now required in scheduling these systems In addition DASS will be able to automatically schedule ground processing and data distribution and to accurately predict consequential load on ground processing data transmission and data storage through self-correcting system-activity models Predicated on the optimized spacecraft service schedules DASS will also continually predict volume and content of space data output as well as its delivery schedule to users Finally DASS will serve as a tool for examining the impact of changes (deletions or additions) in the constellation of satellites serviced by NASA In the initial phase of this RTOP the DASS concept will be developed and refined The second phase will be the identification of specific required software and the scheduling algorithms to be employed The final phase will be the development of a prototype DASS model and experimental exercise of the system This work will be coordinated with the OAST NEEDS Program and the OSTDS Advanced Systems Program

W81-70222 **506-54-83**
Langley Research Center Hampton Va
INTELLIGENT SYSTEMS RESEARCH
C T Woolley 804-827-3871
(506-54-73)

The research objective of this plan is to advance Intelligent Systems technology to enable the design development and utilization of advanced systems for future space robotics applications including space assembly space manufacturing and space servicing of satellites To achieve these objectives the program focus will be to conceptualize investigate and verify algorithms sensors, actuators software and system architecture required for automated space operations Specific near-term objectives are (1) development of a prototype multi-arm manipulator to be used for space assemlby studies (2) development of high speed processing techniques and hardware for specialized algorithms such as numerical integration filtering and matrix manipulation and (3) development of multiple-arm coordination techniques and software

W81-70223 **506-54-85**
Jet Propulsion Laboratory, Pasadena Calif
ROBOTICS/MACHINE INTELLIGENCE AUTOMATED SYSTEMS
Carl Ruoff 213-354-6101
(506-61-16 199-60-60 199-60-80 906-75-27 506-54-75)

The overall objective of this RTOP which supports the PASO objectives in Machine Intelligence and Robotics is to develop and demonstrate laboratory versions of sensing and control technologies for automated systems and robots A specific objective is the development of a visual subsystem for control applications In FY-81 work toward this objective will include (1) developing object models useful for tracking of three dimensional objects (2) developing stereo object recognition algorithms for simple objects in arbitrary poses (3) developing initial stereo tracking algorithms which work at one-half normal frame rates and (4) cooperating with NASA-Goddard on the use of the Massively Parallel Processor prototype in real-time scene analysis

W81-70224 **506-54-93**
Langley Research Center Hampton Va
ADVANCED SPACECRAFT POINTING AND CONTROL SYSTEMS
J D Shaughnessy 804-827-3917

The objectives of this RTOP are the development of analysis tools conceptual design and hardware for precision pointing and control components and systems the development of long life cost effective navigation guidance and control systems concepts and the development of large space structures control and pointing technology To achieve these goals new devices concepts and analyses are being pursued These include (1) spacecraft attitude control momentum storage devices such as the magnetically suspended Annular Momentum Control Device (AMCD) (2) analytical studies of the stabilization and control of large space structures and (3) analytical studies of optimal maneuvering of large space structures Through these efforts technology is being developed to permit the design and implementation of cost-effective spacecraft pointing and control systems System and component requirements as well as conceptual designs are being defined through the use of analysis and simulation Effective system configurations low-cost system integration multipurpose operation and component standardization will be used to reduce system and components costs while achieving required performance Development of control and sensor hardware will be undertaken and critical hardware elements will be carried through laboratory evaluation to establish feasibility

W81-70225 **506-54-95**
Jet Propulsion Laboratory Pasadena Calif
PRECISION POINTING AND CONTROL TECHNOLOGY (PPACT) DEVELOPMENT
S Z Sirmay 213-354-4431

The long range objective of this RTOP is to develop and verify innovative pointing and control technology for spacecraft control systems with emphasis on resource efficiency low cost and reduced weight and power on future planetary space vehicles Specifically these objectives will be achieved through ground and on-board automation, improved resource/performance tradeoffs and control system architecture for multiple missions and versatile hardware inventory to support multiple mission capability Additionally mission operation costs will be reduced The principle RTOP tasks in FY-81 involve developments of the fiber optics rotation sensor (FORS) for long life and low drift performance optical measurement technology for enabling navigation to comet asteroid and other planetary missions and on-board model error estimation for control of vehicle dynamics The objectives for FY-81 are to (1) complete integration and evaluation of the microprocessor and software with the all waveguide fiber optics gyro (2) complete the OMT demonstration system design and software and initiate system tests (3) demonstrate basic technology for on-board estimation of dynamical errors due to wobble and nutation in a representative flexible spacecraft The approach used to achieve these objectives will be to (1a) evaluate FORS waveguide component performance parameters (1b) integrate waveguide components microprocessor software and drive electronics into the FORS 2 design and complete modulated performance tests (2a) evaluate CCD sensor centerfinding algorithms applicable to on-board measurement extraction (2b) develop and demonstrate on-board data extraction and compression software (2c) initiate evaluation of the demonstration camera system in the OMT laboratory facility (3a) determine the model errors inherent in the Galileo attitude estimator design (3b) determine types of on-board data required to achieve model error estimation (3c) develop estimator designs capable of on-board detection of spacecraft dynamics and evaluate performance through computer simulation

Space Power and Electric Propulsion Research and Technology

W81-70226 **506-55-12**
Lewis Research Center Cleveland Ohio
ADVANCED ENERGETICS
Thomas H Cochran 216-433-6897
(506-55-72)

The objective of this effort is to investigate advanced concepts in energy processing for space applications The energy processing elements include the areas of (1) sources (2) conversion techniques and devices, (3) storage and (4) transmission or distribution systems and components Concepts to be investigated in this program are those considered to be high risk and innovative but if successfully developed could provide substantial performance improvements for space missions beyond the 1990 s Advanced energetics will be identified by literature search and communication with leading researchers The concepts will be assessed by in-house and contracted studies and analysis Experiments and theoretical efforts will be conducted on key technologies to demonstrate concept feasibility Selections will be made from among the competing concepts for follow-on system testing

W81-70227 **506-55-13**
Langley Research Center Hampton Va
ADVANCED RADIANT ENERGY CONVERSION
F Hohl 804-827-3781

The objective is to conduct basic research on and to evaluate advanced concepts for the generation transmission and conversion of energy in space Research will be performed to characterize radiation-induced plasmas leading to efficient high-power conversion of concentrated solar and nuclear energy directly into electromagnetic radiation laser power or work Radiation-induced plasmas will be studied to determine population inversion nonequilibrium emission and ionization and excitation cross sections The possibility of new lasers in the ultraviolet and visible region with greatly increased power output will be studied Studies for the selection of the most promising lasing medium and transitions will be performed for direct solar excitation Nuclear-pumped laser tests will be completed during fiscal year 1981 by using the U S Army Pulse Radiation Facility at Aberdeen Maryland and other reactors Intense broadband UV and visible photon sources in operation and under development at LaRC will be used to experimentally investigate broadband pumped chemically reversible lasers and plasma heating Efficient methods of converting broadband and monochromatic photon energy directly to electricity and storable hydrogen and oxygen by photochemical conversion will be developed The RTOP has sufficient flexibility to take advantage of unique opportunities and concepts to advance space energetics research Various grants and contracts will be used to perform supporting research under this RTOP

W81-70228 **506-55-15**
Jet Propulsion Laboratory, Pasadena Calif
ADVANCED ENERGY TECHNOLOGY
E Y Pawlik 213-354-3455
(506-23-15)

The objective of this RTOP is to identify and evaluate and if justified recommend for additional OAST funding innovative

advanced concepts in the areas of energy collection conversion transmission and storage which show promise to enable or significantly enhance future space missions In cooperation with Lewis Research Center new and existing concepts will be evaluated This evaluation will systematically address the basic feasibility of the concept problem areas and potential value when developed This work is necessary to provide the fundamental understanding required to advance our capability to explore and use the extraterrestrial environment The highest ranking concepts will be subject to a more detailed assessment This assessment might include systems studies analytical modeling and/or test evaluation of experimental hardware The results of these detailed assessments will be evaluated and concepts of outstanding or potential merit will be recommended for separate funding by OAST The specific concepts to be investigated in FY-81 are (1) advanced energy storage systems, (2) MHD energy conversion and (3) alkaline metal thermoelectric converter Additional categories in which concepts may be considered are spacecraft tether power generation advanced photovoltaic concepts advanced heat rejection and advanced optics for solar energy conversion

W81-70229 **506-55-19**
Marshall Space Flight Center Huntsville Ala
LASER PROPULSION
R J Richmond 205-453-3710

A technology base for laser propulsion is being developed Laser radiation absorption experiments using pure hydrogen seeded hydrogen and other propellant gases will be conducted Experimental results will be compared with analytical predictions and generalized thruster design model developed Parametric analyses of thrusters using various propellants will be conducted The more promising configurations will be selected for further analyses and finally one configuration will be selected for fabrication and testing

W81-70230 **506-55-22**
Lewis Research Center Cleveland Ohio
ELECTRIC PROPULSION TECHNOLOGY
R C Finke 216-433-6119

The overall program objective is to identify and develop the technology for future electric propulsion systems for application to planetary and Earth orbital missions Technology for auxiliary electric propulsion systems will be identified and developed for stationkeeping and attitude control of geosynchronous spacecraft and future large space systems Tests and analyses will be performed to verify the lifetime of the baseline 30cm mercury ion thruster and fully characterize its interfaces and this information will be transferred to the user community An extended performance program is directed toward improving the performance of the 30cm mercury thruster system in order to enable new planetary mission capability The advanced primary propulsion technology program will define and develop primary electric propulsion technology to enhance the performance and reduce the cost of Earth orbital missions Promising technology concepts will be defined by analyses study and by basic research activities Focused technology activities will be performed in order to characterize the performance and interfaces of critical elements of electric thruster systems, such as thrusters and power processors Tests and analyses of the critical system elements will then be performed to assure element interface compatibility and evaluate their lifetime and performance Work will be performed both by in-house and contracted efforts

W81-70231 **506-55-32**
Lewis Research Center Cleveland Ohio
ION THRUSTER RESEARCH AND ION BEAM APPLICATIONS
R C Finke 216-433-6119

The aim of this RTOP is to obtain an understanding of the physical processes inherent in electric propulsion systems investigate concepts to improve the performance reliability and durability of ion thrusters conceive and investigate advanced electric propulsion concepts and enable the development of new or improved materials processes and products through non-propulsive application of ion thruster technology

W81-70232 **506-55-35**
Jet Propulsion Laboratory, Pasadena Calif
MPD THRUSTER SYSTEM TECHNOLOGY
L K Rudolph 213-354-3478
(506-55-15 506-55-65 506-55-75)

The objective of this RTOP is to pursue research into the controlling physical processes involved in electric propulsion, to evaluate advanced concepts such as the magnetoplasma-dynamic (MPD) accelerator and to investigate the nonpropulsive applications of electric propulsion technology The FY-81 objective is to complete the preliminary technology development and evaluation of the MPD accelerator With successful demonstration of this technology, efforts can then proceed with thruster development Specifically, this effort establishes the fundamental viability of the magnetoplasmadynamic thruster by demonstrating that the problems limiting performance and lifetime can be resolved The approach will be to (1) evaluate the technology associated with operating quasi-steady state MPD thrusters with pulsed energy transfer systems (2) define the potential performance, efficiency and lifetime of the MPD thrusters (3) conduct a preliminary conceptual study of how an MPD thruster might be incorporated into either solar electric propulsion or a nuclear electric propulsion vehicle and (4) provide basic understanding of the physical processes involved in electric thrusters and the application of this technology to plasmadynamic lasers Specific thruster performance goals for this program include thrust densities over 10 to the third power N/M(2), exhaust velocities between 20 and 100 km/sec thrust efficiencies over 50 percent and a lifetime commensurate with projected applications including deep space exploration

W81-70233 **506-55-42**
Lewis Research Center Cleveland Ohio
SOLAR CELL TECHNOLOGY
H W Brandhorst 216-433-4000

The objective of this RTOP is to improve conversion efficiency as well as reduce mass reduce cost and increase operating life of solar cells and blankets Research and technology programs will be continued in the following areas radiation damage mechanisms in silicon solar cells high efficiency silicon solar cells very thin cells with coplanar back contacts and reduced absorptivity processes for fabricating cells at low cost thin flexible encapsulants and modules gallium arsenide solar cells and substrates and concepts with the potential for 30% and 50% solar energy conversion

W81-70234 **506-55-43**
Langley Research Center Hampton Va
SOLAR CELL RESEARCH
E J Conway 804-827-3781

This basic research program is broadly oriented toward developing the technology to improve conversion efficiency reduce mass reduce cost and increase the operating life of GaAlAs/GaAs solar cells The R & D to achieve high efficiency (18 to 20 percent in space) GaAlAs/GaAs solar cells with high temperature (200 to 300 C) operating capability low weight and long life in a radiation environment is being performed for potential space applications, such as long duration solar electric propulsion (SEP) a space power station or a near Sun mission This program emphasizes the effects of proton irradiation on cells and cell materials optimization of the structure to maximize radiation stability and annealing to heal radiation damage The long-term stability of cells and contacts at 200 C is studied to support concentrator and continuous annealing modes of operation A third research emphasis involves thin crystal p-n junction cells for high power to weight ratio space cells Liquid phase and chemical vapor deposition epitaxial growth techniques are employed to develop improved cells In addition the program generates cell concepts and techniques through funding and encouragement of universities and industries If there are unique or novel opportunities that arise funds and manpower will be shifted to address these areas

W81-70235 **506-55-45**
Jet Propulsion Laboratory Pasadena Calif
PLANETARY SOLAR ARRAY RESEARCH AND TECHNOLOGY
Walter A Hasbach 213-354-6132

The primary objective of this RTOP is to develop the technology necessary to increase interplanetary and geosynchronous planar array power-to-mass performance through improvements in blanket efficiency blanket mass, and solar array structural mass The goal is to increase the specific power of a 12 5 kW array from 66 W/kg to 240 W/kg by increasing the blanket efficiency from 7 percent to 10 percent and reducing both the blanket mass and structural mass by 60 percent from the current values of 9 4 kg/kW and 5 8 kg/kW Blanket specific power will thereby be increased from 106 W/kg to 350 W/kg A second objective of this RTOP is to develop low mass concentrator arrays for use on geosynchronous and interplanetary missions A last objective is to assist NASA in evaluating the performance applicability and radiation susceptibility of newly designed solar cells The following tasks support the above objectives and targets of the FY-81 PASO (1) develop for flight qualification testing a > 250 W/kg blanket consisting of OAST thin silicon solar cells Demonstrate and advanced blanket concept capable of > 350 W/kg employing second generation OAST thin cells (2) develop new low mass structure and deployment concepts for advanced planar and concentrator enhanced photovoltaic arrays As a goal this technology should be capable of 240 W/kg at operating temperatures in GEO and > 10 W/kg at 6 angstrom units (Jupiter) (3) test and evaluate cell technology developed by the Department of Energy for applicability to space power needs (4) publish an update of the Solar Cell Radiation Handbook and (5) develop a technology for fabricating epitaxial GaAs on single crystal Si substrates with solar cell efficiencies of at least 16% (AMO) and having less than 10% efficiency loss after an equivalent 10-years radiation exposure in synchronous orbit

W81-70236 **506-55-52**
Lewis Research Center Cleveland Ohio
ELECTROCHEMICAL ENERGY CONVERSION AND STORAGE
Lawrence H Thaller 216-433-4000

The objective of this program is to attain long life high energy density high reliability and lower cost of electrochemical energy storage and conversion devices The emphasis is on metal-gas and alkaline component technology high energy density batteries and multikilowatt hour storage technology which includes H2-O2 alkaline fuel cells to operate with long endurance and higher efficiency During FY-81 the development of crosslinked polymeric separators for alkaline and high energy batteries will continue The > 200 Whr/kg chalcogenide positive-sodium negative cell will be characterized Work on new polymeric separator materials for high energy non-aqueous lithium cells will continue An optimum Ni/Cd cell design for rapid deep discharge-reconditioning will be completed Technology of very high capacity long life batteries and fuel cell electrolyzer systems will continue with added emphasis on Ni/H2 cells The 100 AHr toroidal Ni/Cd cell feasibility will be completed The evaluation of alkaline electrolysis oxygen electrocatalyst will continue testing at higher pressures and the single cell technology optimization toward longer life will be pursued

W81-70237 **506-55-55**
Jet Propulsion Laboratory, Pasadena Calif
ADVANCED NICKEL-CADMIUM AND LITHIUM BATTERIES
I Stein 213-354-6048
(506-23-22)

This RTOP supports the PASO specific objectives to achieve improved performance energy density and lifetime as well as to extend the operational capability of space batteries for interplanetary and Earth-orbital missions The effort involves three tasks (1) An improved set of processing and test specifications will be formulated to achieve a ten year life battery A major FY-81 objective is to complete the nondestructive evaluation techniques for application to cell-life predictions The approach is to obtain a fundamental understanding of the mechanisms of failure and degradation modes by applying both destructive and nondestructive evaluation methods and accelerated test techniques (2) Safe and reliable primary lithium batteries with higher energy density (greater than 300 Whr/kg) and longer life (greater than 5 years) than existing primary batteries for future NASA missions will be developed A major FY-81 objective is to identify key controllable factors that will permit cells to be 100% safe The approach involves two parallel efforts a basic research effort to identify improved cell materials or technology and a developmental effort to incorporate and evaluate these new materials and technologies in practical cells and subsequently in prototype batteries Secondary lithium batteries will be developed with an energy density of 200 Whr/kg and greater than 5 year lifetime A major FY-81 objective is to determine key processes/reactions that limit performance The approach is to achieve a fundamental understanding of the electrochemical processes which govern performance A materials and electrode processes research effort to improve the anode cathode and electrolyte in the cell will be incorporated in a developmental prototype cell effort

W81-70238 **506-55-57**
Lyndon B Johnson Space Center Houston Tex
ORBITAL ENERGY STORAGE AND POWER SYSTEMS (H2/O2)
Hoyt McBryar 713-483-6128

The objective of this research effort is to advance fuel cell and electrolysis cell technology to maturity and to demonstrate suitability to large orbital energy conversion and storage requirements of high power and long life A data base will be developed at the cell and component level This will provide the basis for design of the larger developmental test articles An interim test will be conducted on breadboard type hardware of about 5-7 kW in the integrated mode This will serve as a testbed to help define technology limitations and to evaluate interaction phenomena of dissimilar fuel cell/electrolysis cell concepts Engineering model hardware will be fabricated which incorporates all technology advances for field demonstration technology readiness The results will provide a basis for selection of the regenerative Fuel Cell over other potential concepts for large orbital energy storage systems

W81-70239 **506-55-65**
Jet Propulsion Laboratory Pasadena Calif
THERMAL-ELECTRIC AND THERMIONIC ENERGY CONVERSION TECHNOLOGY
Jack F Mondt 213-354-6847

The overall objective is to develop thermal-to-electric energy conversion technology to provide electrical power for propulsion and science as required to explore our solar system and its surroundings Desirable characteristics of such a power system are low weight low volume long life high reliability power level flexibility minimum integration complexity maximum safety and low cost The enabling technology is divided into four tasks (1) NEP System Technology A power subsystem design which is compatible with the mission requirements will be provided The critical conversion technologies to be developed will be delineated and interface technologies between the energy conversion device and the heat source and heat rejection subsystem will be developed (2) NEP Conversion Technology Thermionic converter concepts will be tested to demonstrate high efficiency and high power density Thermoelectric materials which exhibit high efficiency high power density and high operating temperature capabilities will be tested and evaluated to demonstrate technology readiness Analytical evaluation of the Brayton cycle conversion technology configured for space power will be continued (3) RTG Technology New advanced thermoelectric materials which theoretically will provide a reliable efficient and cost effective conversion system and is compatible with existing radioisotope heat sources are investigated under this task The advanced materials are fabricated and tested at temperature to determine their thermoelectric properties (4) STG Technology A solar thermoelectric technology capable of surviving the environments of near-Sun missions is being evaluated Selected generator concepts will be designed and tested

to demonstrate technology readiness A Resident Research Associate (RRA) is supported by this RTOP

W81-70240 **506-55-72**
Lewis Research Center, Cleveland Ohio
POWER SYSTEMS MANAGEMENT AND DISTRIBUTION
R C Finke 216-433-6119

The objective is to provide the technology base for multi-kW space power systems and subsystems including power interface energy storage electrical components circuit concepts environmental interactions with space plasma, power processing transmission and distribution needed for semipermanent low earth and geosynchronous power systems in the mid 1980's to mid 1990 s The proposed work will define and develop the technology necessary to both extend shuttle capabilities and establish central utility power capabilities essential to the habitation and development of near Earth space In house and contractor studies will be conducted to determine performance requirements identify system constraints estimated cost weight and size of potential space power systems identify new technology needs and determine benefit/cost ratio of proposed technology programs Contractor/in house analysis and experimentation will be used to define develop and test components circuit concepts subsystems and systems Investigations will be conducted to evaluate interactions between the space plasma environment and spacecraft surfaces at various voltages Design guidelines for controlling these interactions will be issued A strong activity will be maintained to coordinate with and support work at other NASA centers

W81-70241 **506-55-75**
Jet Propulsion Laboratory Pasadena Calif
PLANETARY POWER SYSTEMS RESEARCH AND TECHNOLOGY
Arthur O Bridgeforth 213-354-5626

The two tasks in this RTOP support the FY-81 PASO specific objective to provide the technology base necessary to control the generation and distribution of energy in future space systems and to assure their environmental compatibility Future planetary exploration missions will result in long round trip communication time and large variations in power system operating parameters preventing the proper management of these power systems through conventional Earth-based monitoring and command functions The objective of the first task is to develop the capability of a spacecraft power system to automatically perform monitoring computational and control functions without the need for ground intervention An existing breadboard power system has been modified to incorporate selected APSM functions to demonstrate technology feasibility The performance of this system will be evaluated and a final report prepared by the end of FY-81 A technology feasibility demonstration of the APSM/V075 Breadboard system will be conducted in the third quarter of FY-81 The objective of the second task is to develop the technology for controlling spacecraft system interactions with the charged particle environment of space This activity is a portion of a joint AF/NASA comprehensive research and technology program on spacecraft environment interactions This technology will be required to provide design information for both large spacecraft missions and high power modules

W81-70242 **506-55-76**
Goddard Space Flight Center Greenbelt Md
ADVANCED POWER SYSTEM TECHNOLOGY
L W Slifer 301-344-8841

The basic objective for this RTOP is to convert power technology Research and Development accomplishments at the various NASA centers and DOD agencies to a state of readiness for future flight applications The approach includes the overall assessment of Research and Development status, the evaluation of technology advancements in terms of potential for flight application the completion of engineering development necessary to bring high potential advancements to technology readiness, and analysis of power systems incorporating the advanced technology The RTOP consists of four tasks (1) power technology assessment (2) analytical modeling of power systems (3) assessment of nickle-hydrogen batteries and (4) assessment of flywheel energy storage

W81-70243 **506-55-79**
Marshall Space Flight Center Huntsville Ala
MULTI-KW LOW COST EARTH ORBITAL SYSTEMS
J R Graves 205-453-2514
(506-55-49)

The objectives of this RTOP are to provide the technology and capability within NASA to process distribute and control electrical power in multi-100 kW type systems and to reduce space energy costs through improved efficiency life reliability and maintenance These objectives will be accomplished via a combination of in-house and contracted efforts and will consist of the following tasks (1) establish component and subsystem requirements sizes frequencies voltages and sensitivities, and rank critical technologies consistent with overall system development (2) design and develop the necessary power processing/conditioning circuitry for high voltage multi-kW power systems (3) develop utility type power management and control techniques for spacepower systems (4) construct a system breadboard for evaluation and demonstration of new technologies and power management and control techniques

Multidisciplinary Research

W81-70244 **506-56-11**
Ames Research Center Moffett Field Calif
FUNDS FOR INDEPENDENT RESEARCH (SPACE)
G T Chapman 415-965-5654
(505-36-11)

Innovative and discretionary basic research in areas related to space are supported by this RTOP The program pursues basic investigations of new technologies in fundamental science and engineering needed to satisfy NASA s requirements in space including the technical fields of lasers energetics materials, applied mathematics superconductivity chemistry and physics The OAST Research Council and the Ames Funds for Independent Research (FIR) Committee review unsolicited proposals that have been judged to be worthy of support on scientific or engineering grounds but have not been selected for support because of funding limitations in other research programs Those research proposals that are judged by the Council and FIR Committee to be worthy of support on a scientific or engineering basis are selected as candidates for funding

W81-70245 **506-56-12**
Lewis Research Center Cleveland Ohio
FUND FOR INDEPENDENT RESEARCH (SPACE)
Marvin E Goldstein 216-433-4000

The objective is to support innovative long range, high risk basic research in areas related to space The program pursues basic investigations of technologies in fundamental science and engineering needed to satisfy NASA s requirements in space including the technical fields of lasers energetics and energy conversion materials science applied mathematics superconductivity chemistry and physics Members of the Lewis Research Advisory Board at the request of the Chief Scientist review unsolicited researCh proposals that have been judged to be worthy on scientific or engineering grounds but have not been selected for support because of their long range or high risk nature or because of funding limitations in the other specific discipline programs Those research proposals that are judged by the Board to be worthy of support on a scientific or engineering basis are selected as candidates for funding These proposals are then *prioritized by the Chief Scientist and funded to the extent permitted* by available resources The Chairman of the OAST Research Council is kept informed of funding plans to prevent duplication and to provide coordination Progress and results are reported periodically by the grant monitor and submitted to the Chief Scientist for review and for distribution to OAST Research Council

W81-70246 **506-56-13**
Langley Research Center, Hampton Va
FUND FOR INDEPENDENT RESEARCH (SPACE)
W D Erickson 804-827-2471

The objective of this plan is to support basic research in universities in areas related to space through the funding of a limited number of unsolicited research proposals from various universities University research proposals that have been judged to be well worth supporting on scientific or engineering grounds but have not been selected for support because of funding limitations in other research programs are considered University research proposals that have been evaluated and are not funded through any of the research programs are reviewed by the Langley University Research Proposal Review Committee Those research proposals that are judged by this committee to be well worth supporting on a scientific or engineering basis are selected as candidates for funding through this plan The committee establishes a priority listing of these proposals and selects those efforts that are judged to be the more innovative and aimed at the longer term research of potential relevance to future NASA space programs

W81-70247 **506-56-16**
Goddard Space Flight Center Greenbelt Md
FUND FOR INDEPENDENT RESEARCH
T Kostiuk 301-344-8431

The objective is to conduct basic research in the field of remote detection spectroscopy and imaging in the middle infrared using infrared to visible upconversion techniques The program pursues a basic investigation of new technology in fundamental science and engineering needed to satisfy NASA requirements in space specifically the development of laser technology and laser systems applicable to highly sensitive infrared detection of atmospheric astronomical and astrophysical sources The approach is to theoretically optimize the design and performance characteristics of intra-cavity upconversion systems construct such systems and experimentally verify theoretical predictions investigate the physics involved analyze and test the application of these systems to astrophysical observations

W81-70248 **506-56-19**
Marshall Space Flight Center Huntsville Ala
FUND FOR INDEPENDENT RESEARCH
R Decher 205-453-5130

The objective of this RTOP is basic research related to NASA s goals of space flight and space research Work covered by this RTOP includes experimental and theoretical studies of more fundamental problems connected with scientific flight experiments advanced scientific instrumentation and advanced technology

W81-70249 **506-56-29**
Marshall Space Flight Center Huntsville Ala
UTILIZATION OF SPACE FOR SCIENCE EXPERIMENTS
George H Fichtl 205-453-0875

The objective of this RTOP is to perform basic research in the areas of fluid mechanics and gravitational physics with a view toward developing experiments which require the unique characteristics of space for their successful accomplishment This research is motivated by the need to resolve fundamental scientific problems and issues which are of significant importance in the areas of pure and applied physics and which relate to national needs The approach for accomplishing this basic research involves a combination of analytical and ground-based experimental efforts The work will be phased according to the requirements of the Physics and Chemistry Experiments (PACE) in Space Committee The effort involves two tasks namely Task 01 - Gravitational Physics and Task 02 - Fluid Mechanics

Information Systems Research and Technology

W81-70250 **506-61-22**
Lewis Research Center Cleveland Ohio
HIGH EFFICIENCY TECHNOLOGY FOR MICROWAVE AMPLIFIERS
R E Alexovich 216-433-6689
(506-54-42 541-02-12 650-60-22)

The objective of this RTOP is to provide through research design data and tests the technology base for development of high efficiency high power microwave amplifiers for space and airborne applications capable of real-time handling of data in space and state-of-the-art jamming power in ECM systems To achieve this, objective research and technology development programs will be undertaken on several types of microwave amplifiers applicable to high efficiency requirements from 1 to 100 GHz Specific techniques such as multistage depressed collectors and spent beam refocusing and development of methods for high efficiency performance in the linear low distortion region will be pursued Investigation of low loss high efficiency circuits will be continued

W81-70251 **506-61-25**
Jet Propulsion Laboratory Pasadena Calif
HIGH SPEED DATA TRANSFER X/S BAND COMPONENTS
James F Boreham 213-354-4107

The general objectives of this RTOP are to develop microwave subsystems and techniques which (1) increase data transfer by a factor of 10 to 100 (2) improve radio navigation accuracy by factors of 10 to 100 (3) improve carrier tracking stability by two orders of magnitude (4) improve communications component reliability by a factor of two and (5) reduce cost and weight of these components by at least one third The development phases for the flight equipment for an X-band uplink capability will be to develop a down converter to interface with a NASA Standard Deep Space Transponder with a flight experiment demonstration on ISPM and develop an integrated X-band transponder with wide band ranging improved phase and group delay stability and adaptability to dual frequency operation as a long term solution for the late 1980 s and beyond Development phases for the X-band Solid State Power MPLIFiers (XEEPA s) will be to develop 10 to 40 watt XSSPA s with overall DC to RF efficiencies of approximately 30% as replacements for the expensive and relatively unreliable TWTA s and using technologies developed for the XSSPA s and the Array Feed Power Amplifiers (FY-78 79) combined with phase shifter and controller technologies develop vernier Electronic Beam Steering Flight and ground system trade off studies will be performed to determine the most cost effective weight efficient and low risk means of achieving the greater telecommunications performances needed for future deep space missions Two flight experiments will demonstrate basic features of the X-band transponder These include (1) a wideband one way delta VLBI ranging capability for the Galileo mission providing improved navigation accuracy at low declination angles and (2) in conjunction with OSIDS RTOP 310-20-64 a phase stable X-band uplink capability for ISPM to permit the search for gravity waves

W81-70252 **506-61-26**
Goddard Space Flight Center Greenbelt Md
HIGH SPEED DATA TRANSFER, S/K-BAND COMPONENTS AND TECHNIQUES
Dominick E Santarpia 301-344-6375

The objective of the work to be accomplished under this RTOP is the advancement of spacecraft technology in tracking data generation and data transfer to satisfy the communications requirements of future flight programs The flight programs of the late 1980 s and early 1990 s are characterized by high data rates simultaneous multiple-links and reliable long life operation The accommodation of such requirements shall be achieved through technological advances in spacecraft RF/microwave techniques and components

W81-70253 **506-61-31**
Ames Research Center Moffett Field Calif
INFRARED DETECTORS FAR IR SENSORS
C R McCreight 415-965-6525
(358-41-06 188-41-55 506-61-41 506-61-43)

The objective of this RTOP is to develop advanced infrared detection systems for astronomical research This program will provide the technology for new and more efficient data acquisition capability throughout the infrared (IR) spectrum (2-120 micron) for the low-background astronomical application It will benefit

the entire NASA IR astronomy program including future programs such as the Shuttle Infrared Telescope Facility (SIRTF) and the Space Telescope (ST) and the on-going ground-based airborne, and balloon-borne programs Activities will include development of hybrid and monolithic arrays of high-sensitivity extrinsic and intrinsic detectors and improved discrete components for ultimate array applications IR array expertise developed by the Department of Defense (DoD) and NASA will be used for wavelengths below 30 micron New IR arrays will be developed for wavelengths beyond 30 micron Activities will also include development of real-time data preprocessing/data compression electronics for use with the arrays in the astronomical application IR detector expertise in industry will largely be used for design fabrication and preliminary testing of the arrays Detailed evaluation of the arrays and electronics will be carried out at Ames and also at university facilities by interested IR astronomers Realistic observational testing will be conducted using existing ground-based and airborne facilities All work performed under this RTOP will be closely coordinated with related DoD and NASA activities

W81-70254 **506-61-33**
Langley Research Center Hampton, Va
SENSOR SYSTEMS TECHNOLOGY
S L Ocheltree 804-827-2791

The objective of this research is to develop and evaluate advanced concepts for infrared ultrasensitive detectors, laser and electro-optic systems, and broadband microwave precision radiometers Principal thrusts are to (1) develop using CCD technology monolithic detector arrays (1-5 and 2-30 microns), high quantum efficiency multi-GHz bandwidth photomixers and calibration-compensate techniques for multispectral scanners (2) investigate laser backscatter and fluorescence techniques for marine water parameter measurement and investigate continuously tunable infrared laser techniques for high resolution absorption and emission spectroscopy and measurement of low concentration atmospheric constituents (3) develop improved radiometer performance resolution stability bandwidth, and reliability through low-loss front end components, broadband devices with flat frequency response and microwave integrated circuit devices Critical technology for a laser heterodyne spectrometer Spacelab instrument will be developed Laboratory breadboard and aircraft testing will be used to demonstrate critical portions of the technology developed effort

W81-70255 **506-61-35**
Jet Propulsion Laboratory, Pasadena Calif
REMOTE SENSING SYSTEMS
Joh Wellman 213-354-7222
(506-18-35 506-54-45 198-10-06)

The objective of this RTOP is to develop and flight test advanced remote sensors (sources and detectors) for terrestrial atmospheric observations from Earth orbit, for astronomical observations from aircraft and Earth orbit for missions to other planets and comets and for supporting laboratory spectroscopy The first element infrared detector array development consists of four interrelated activities to develop infrared array instrument systems (1) requirements definition (2) technology development (3) experimental evaluation and (4) field demonstration The second element high resolution lasers techniques for ultraviolet-visible laser remote sensing is directed toward a demonstration of the unique capabilities of an active ultraviolet laser system to measure concentrations of trace atmospheric species from airborne and spaceborne platforms This demonstration phase follows the successful development of an appropriate excimer laser in a task funded separately by the Electronic branch of OAST The third element development of submillimeter wavelength components addresses four major component areas in submillimeter technology (1) development of efficient quasi-optical techniques for receiver front ends (2) development of techniques for efficient coupling of radiation to nonlinear devices (3) development of appropriate efficient nonlinear submillimeter devices and (4) development of local oscillator sources for the submillimeter region This is a relatively new technology for which low-noise sensors operating at frequencies up to 2000 GHz (wavelengths shorter than 0 15 mm) are urgently needed

W81-70256 **506-61-36**
Goddard Space Flight Center Greenbelt Md
SENSOR SYSTEMS
J J Degnan 301-344-7714

The objective of this RTOP is to develop and flight-test advanced sensors in support of NASA programs in geophysics astronomy atmospheric chemistry climatology, topography oceanography and earth resources The sensors being investigated are both active and passive and span the near ultraviolet through microwave regions of the electromagnetic spectrum The RTOP is subdivided into three principal elements The first element entitled High Resolution Lasers encompasses the sensor systems which use lasers either as probes in active lidar systems or as local oscillators in passive heterodyne radiometers Systems under development include a centimeter resolution laser ranging/altimetry system a CO2 differential absorption Lidar a tunable dye lidar and a passive submillimeter wave heterodyne radiometer The second element entitled 'Infrared Linear Detector Array Development is directed toward the development of passive multispectral linear array instruments which operate primarily in the 1-4 and 8-12 micrometer spectral regions of the near infrared This includes the development of pushbroom mode sensor systems and appropriate arrays and all-reflective optical systems for operation in the infrared The objective of the third element entitled 'Multifunction Microwaves, is to develop the advanced technology and system concepts for active and passive microwave and millimeter wave sensing of the earth s environment in selected bands from 0 6 to 225 GHz Major tasks within this element include development of improved millimeter wave radiometer system components such as mixers oscillators, filters and antennas and advanced multichannel active and passive microwave imaging systems

W81-70257 **506-61-37**
Lyndon B Johnson Space Center, Houston Tex
ADVANCED SYNTHETIC APERTURE RADAR TECHNOLOGY
K Krishen 713-483-2846

The day/night all-weather high resolution features of synthetic aperture radars provide an applications tool not available with any other remote sensor The present state-of-the-art capabilities of spaceborne imaging radars include single-frequency single polarization and swath-widths up to 100 km The objective of the Advanced Synthetic Aperture Radar (ASAR) Project is to develop and demonstrate technology for SAR systems with new functional and performance capabilities for missions planned for 1985-1995 period Specifically, the ASAR goals include wide-swath selectable frequency of the transmitter selectable polarization and bandwidth precise amplitude calibration to 0 5 dB The immediate objective of the ASAR will be to demonstrate the technology for a multimode SAR capable of generating wide-swath at four frequencies and all linear polarizations Long antenna (beam shaping) and electronic scanning techniques will be investigated for wide-swath implementation The system technology will be demonstrated by acquiring data with an end-to-end system from an aircraft The goal of the system design will be such that it is scalable for space use Areas not addressed in the initial design/development such as elevation imaging will be identified and prioritized for future development

W81-70258 **506-61-43**
Langley Research Center Hampton Va
INSTRUMENT POINTING SYSTEMS
C R Keckler 804-827-3917

The objectives of this RTOP are to develop and demonstrate techniques and systems capable of providing high accuracy pointing and stability (approximately 0 01 arcseconds) for experiments dedicated to stellar, solar and terrestrial observations as well as interplanetary investigations To achieve these goals, new concepts devices and analyses are being pursued These include the development of techniques and systems for Earth-feature identification acquisition and tracking as exemplified by the Video Landmark Acquisition and Tracking (VILAT) system and new approaches to high accuracy pointing and stabilization of an experiment through the use of the Annular Suspension and Pointing System (ASPS) which utilizes magnetic suspension

Through these efforts technology is being established to permit the achievement of mission objectives during the Shuttle era in a cost-effective manner Systems and components are developed and tested and system performance in orbit predicted through simulations Effective system configurations low-cost system integration, multipurpose operation and utilization will be used to reduce systems costs while achieving required performance Development of control software and hardware will be pursued and evaluated in the laboratory prior to their flight verification onboard the STS These efforts are being directly coordinated with GSPC JSC, MSFC and JPL

W81-70259 **506-61-46**
Goddard Space Flight Center Greenbelt, Md
SENSOR COOLING SYSTEM
Allan Sherman 301-344-5405

The overall objective of the cryogenics program is to provide low temperature technology which will be applicable to the large number of future missions that will require instrument cryogenic cooling The program to accomplish these objectives includes technology development in the areas of mechanical coolers and solid cryogen coolers The approach for the mechanical cooler R&T program is (1) develop 3 to 5 year 65 K lifetime cooler technology and prototype models utilizing a linear drive and noncontacting bearings and seals and (2) extend the 3 to 5 year technology to the development of a 12 K mechanical cooler The objectives of the solid cryogen program are (1) lifetime/capacity enhancement for a given size (2) temperature range extension down to 8 K and (3) wider range of application for a given cooler system design The program approach includes technology demonstration tests and systems development

W81-70260 **506-61-53**
Langley Research Center Hampton, Va
NASA END-TO-END DATA SYSTEM INFORMATION ADAPTIVE SYSTEM
W Lane Kelly 804-827-3535
(506-61-13 506-54-63)

The primary objective of the Information Adaptive System (IAS) activity is to develop and demonstrate an on-board spacecraft data system which adaptively controls and processes sensor data The IAS will interface directly with Earth resources and environmental monitoring sensors to provide on-board data control, formatting calibration, preprocessing data set selection and feature classification The key hardware and software components required to implement a ground demonstration of the IAS will be developed and laboratory brassboard of the IAS will be demonstrated and evaluted in a simulated real-time data environment IAS system design studies have been completed Key IAS components have been identified and specified for development under contract in support of the brassboard demonstration The Information Adaptive System is an essential element of the NASA/OAST NASA End-to-End Data System program and will provide a significant contribution in attaining the goals of this program

W81-70261 **506-61-55**
Jet Propulsion Laboratory Pasadena, Calif
NASA END-TO-END DATA SYSTEM
Donald D Lord 213-354-4117
(506-61-15 506-61-15 540-01-15)

The objectives of this effort are to define the system configurations and to develop enabling techniques and technologies which will significantly improve the effectiveness and efficiency of the NASA-wide information system for the 1980 s The principal emphasis of this effort will be directed towards identifying and resolving problems related to the Deep Space System The approach includes performing a number of related tasks addressing key elements of the end-to-end system Each of these tasks will be carried out so as to support and contribute to the activities of the established teams within the overall NEEDS program by representing the interests of the deep space community Cooperative participation and continuing technical exchanges with other NASA centers is expected to aid in the identification of common (NASA-wide) approaches to a more effective and efficient end-to-end data system Major categories of tasks include (1) Systems systems engineering methodology development and technology assessment (2) Modular Data Transport System (MDTS) spacecraft data system channel coding data compression and automated ground transport of telemetry (3) Data Base Management System (DBMS) DBMS systems/technology studies and the prototype implementation of elements of a deep space DBMS (4) Information Adaptive System (IAS) Optical Navigation Information Adaptive System (5) Command and Control (CC) Technology and requirements evaluation Individual demonstrations and/or reports are planned to aid in the technology transfer process from the NEEDS efforts into flight project activities

W81-70262 **506-61-56**
Goddard Space Flight Center Greenbelt Md
NASA END-TO END DATA SYSTEM (NEEDS) PHASE 2
R D Price 301-344-7377
(506-61-53 506-61-55 506-61-59 506-61-16)

The NASA End-to-End Data System (NEEDS) extends from the detection of an event by a sensor to the output of data to the user and includes the planning and feedback of conditioning to the sensor for event detection the objective of the NEEDS Program is to significantly increase the effectiveness and efficiency of this system through the development of advanced technologies and techniques The broad objectives of Phase 2 are to develop and demonstrate subsystems and to define data systems configurations operational procedures and data handling techniques which will enable real-time data management The approach will be to conduct a continuing systems analysis to guide and evaluate the program to develop new subsystems and operations concepts and to integrate and test-demonstrate at the prototype level the composite system The Goddard Space Flight Center (GSFC) as lead center on this program has responsbility for overall program management and coordination and leads or participates in most of the technology development More specifically the technical approach has been divided into nine tasks (1) systems level support including program management and tradeoff studies (2) development of advanced data system concepts (3) information adaptive systems concept development (4) onboard image correction study (5) onboard ancillary data module study (6) modular data transport system development (7) data base management system software development (8) parallel processor development and (9) study of command and control concepts

W81-70263 **506-61-59**
Marshall Space Flight Center Huntsville, Ala
NASA END-TO-END DATA SYSTEM (NEEDS) DATA BASE MANAGEMENT/ARCHIVAL MASS MEMORY
D T Thomas 205-453-3577

The objectives are to develop and demonstrate the low cost modular Data Base Management System (DBMS) and Archival Mass Memory (AMM) system Space-acquired data will be received and recorded by the DBMS at rates up to 80 MB/sec user-access time will be reduced (compared with previous systems) by a factor of 100 Input/Output rates up to 50 MB/sec will be routine for the AMM it will provide online archival-quality capacity up to 10 to the 12th power bits with 10 to the 13th power off line and expandable to 10 to the 15th power

Spacecraft Systems Research and Technology

W81-70264 **506-62-43**
Langley Research Center Hampton, Va
LARGE SPACE STRUCTURES SYSTEMS TECHNOLOGY
R L James 804-827-4606

Promising antenna and platform system concepts and supporting technology are being development and tested to meet the needs of the NASA missions of the 1980 s The development activities include the evaluation of erectable and deployable structures and the assembly thereof utilizing composites and other advanced materials The supporting technology disciplines of stabilization and control techniques and their interaction with the structure materials surface measurements and control techniques, and the utilization of interactive design and analytical programs are being fully explored and advanced by this program effort Further, the antenna and platform requirements in the 1985 to 2000 time period will be examined so that technology

developed for the near term missions can be cost effectively extended for larger and more complicated systems The Langley Research Center is the lead center for Large Space Structures Systems Technology Program and the program will be managed by the Large Space System Technology (LSST) Program Office at Langley The LSST Program Office will plan and coordinate the technology development tasks among six participating NASA centers

W81-70265 **506-62-55**
Jet Propulsion Laboratory, Pasadena Calif
PLANETARY AND SOLAR SPACECRAFT SYSTEMS AUTOMATED OPTICAL NAVIGATION
Allan R Klumpp 213-354-4209
(506-61-45 506-62-25 506-54-75 199-60-60)

The objectives of this work unit are (1) to develop and demonstrate ground-automated systems for optical navigation with significant new and improved capabilities and (2) to develop the technology base for autonomous onboard navigation systems required by advanced post-Galileo missions The approach includes analysis and assessment of present and anticipated navigation requirements, development of a prototype system to demonstrate the concepts on the Voyager mission and development of the prime optical navigation system for the Galileo mission The long-range goal is to increase navigation accuracy and scientific data acquisition capability while decreasing total costs The Automated Optical Navigation system (AON) will extract navigation measurements from full-frame TV images, determine a best-estimate orbit and compute a trajectory correction maneuver as a spacecraft approaches its intended target Its use can reduce navigation costs of future Galileo-type missions by over $0 5 million per mission and future Voyager-type missions by over $0 25 million per mission A prototype system on the IBM 370 mainframe computer was demonstrated in FY-79 on the Voyager Jupiter encounters An advanced system on the MODCOMP IV minicomputer will be demonstrated in FY-81 on the Voyager Saturn encounters Subsequently the system will be readied for Galileo supported primarily by OSS Design options and programming language have been chosen to facilitate adapting the system to an onboard computer when required for foreignbody landers sample returns and other advanced missions The technical plan for the AON work unit is consistent with the 17 Feb 1978 joint OAST/OSS Memorandum of Understanding Development of Approach Optical Navigation Automated Data Processing on the JPL Realtime Minicomputer System

W81-70266 **506-62-62**
Lewis Research Center Cleveland Ohio
EARTH ORBITAL PLATFORM SYSTEMS - AUXILIARY ELECTRIC PROPULSION FOR SPACECRAFT SYSTEMS
R C Finke 216-433-6119

The overall program objective is to charactertize and verify the 8 cm thruster subsystem design and to provide for transfer of the technology to the user community The performance lifetime, and interfaces of the 8 cm subsystem will be defined and verified in a ground program and a flight test of two subsystems on the Air Force P80-1 satellite Data from the ground and flight program will be evaluated, compared, and reported Relevant results and program status and plans will be provided on a timely basis to the interested community Works will be performed both by in-house and contracted efforts

W81-70267 **506-62-67**
Lyndon B Johnson Space Center Houston Tex
THERMAL MANAGEMENT FOR ON-ORBIT ENERGY SYSTEMS
W E Ellis 713-483-4941

The objective of this RTOP effort is to (1) develop the technology necessary for thermal management of a large space power or operation system (2) extend orbital lifetime capability of thermal management systems from months to several years and (3) provide the technology necessary for high energy density heat collection and transport This will be achieved by the design development, fabrication and test of prototype hardware comprising a representative portion of a full scale system Such a system might consist of an osmotic heat pipe providing a constant temperature thermal buss or energy transport loop that would deliver or receive heat to/from the various systems and payload heat sinks or sources via one or more types of modular (i e easily connectable/removable) thermal interface devices (contact heat exchangers fluid or heat pipe quick disconnects etc) The primary heat sink for such a system could be made up of relatively simple independent radiator elements containing large high-capacity dual-passage heat pipes that would provide a space constructable radiator system with long life due to low system vulnerability to the micrometeoroid environment

Transportation Systems Research and Technology

W81-70268 **506-63-11**
Ames Research Center Moffett Field Calif
SPACE SHUTTLE CONFIGURATION AND AEROTHERMODYNAMICS
J G Marvin 415-965-5390

The objective is to provide the analytical and experimental support to the Shuttle Program Office as required for aerothermodynamic design development and verification of the shuttle orbiter launch and ferry configurations and subsystems The necessary expertise and facilities will be provided to support in-house and program-generated action items as required during the design development and verification of the Space Shuttle

W81-70269 **506-63-13**
Langley Research Center Hampton Va
SPACE SHUTTLE DEVELOPMENT SUPPORT
J P Arrington 804-827-3911

This RTOP focuses Langley s expertise in configuration aerothermodynamics and operational flight mechanics on specific Shuttle development requirements and problems The RTOP supports the Shuttle program by (1) providing time in Langley ground-based facilities for direct OSTS/contractor-requested support (2) continuing independent in-house Shuttle technology and development studies and (3) responding to specifically requested task-study areas from the Program Office at JSC In addition Langley will perform independent evaluations and assessments of the configurations and operational flight mechanics as necessary This RTOP s program is coordinated with other NASA Centers and the Phase C/D contractor through appropriate Program Office coordination panels at JSC

W81-70270 **506-63-27**
Lyndon B Johnson Space Center Houston Tex
ACIP - (AERODYNAMIC COEFFICIENT IDENTIFICATION PACKAGE)
Ernest L Weeks 713-483-4661

The objectives of the propoposed experiment system are twofold (1) to acquire high quality flight data for postflight aerodynamic coefficient estimation and (2) to provide flight dynamic state variable data which would support other technology areas such as aerothermal or structural dynamics The proposed experiment consists of an instrumentation package and baseline Orbiter data which will provide flight mechanics data for the determination of aerodynamic coefficients from Orbiter flight data The data from the system will also provide appropriate reference conditions for other aerothermal and flight dynamics experiments This experiment would require power time correlation environmental support and a suitable structural location from the orbiter

W81-70271 **506-63-31**
Lyndon B Johnson Space Center, Houston Tex
OEX (ORBITER EXPERIMENTS) PROJECT SUPPORT
P D Gerke 713-483-3987

The Orbiter Experiments (OEX) Program has been initiated jointly by JSC and OAST to utilize the space shuttle as a research vehicle The program objective is to collect data in the technology disciplines that will augment the research and technology base for future spacecraft design Flight data relative to these disciplines will be collected by utilizing the currently planned development flight instrumentation (CDI) configuration by modifications and/or augmentations to the present orbiter flight tests (OFT) baseline instrumentation and by development of unique experiments beyond the DFI capabilities for flight on the orbiter Studies will be conducted to determine the optimum method of utilizing the shuttle system to conduct research and

technology These studies will be augmented by investigations to develop experimental programs that would obtain research and technology data in flight regimes applicable to advanced space transportation systems The primary goal of these studies is more efficient utilization of the STS capabilities to obtain data required to advance the current state of spacecraft technology This RTOP includes the effort associated with overall project management project support, experiment development initiation experiment compatibility assessments experiment itegration activities and integration hardware development initiation The experiment development effort is the subject of additional RTOP s from the appropriate NASA Centers

W81-70272 **506-63-32**
Langley Research Center Hampton Va
SHUTTLE ENTRY AIR DATA SYSTEM (SEADS)
P M Siemers 804-827-3984
(506-26-13 506-26-33 506-26-43)

To extend the knowledge of aerodynamics aerothermodynamics and basic fluid mechanics into flow regimes previously inaccessible to the investigator through extraction of flight data during routine operation of the shuttle orbiter This knowledge will be applied (1) to verify and increase the reliability of sophisticated computational prediction codes (2) to develop procedures to extrapolate windtunnel data to flight conditions (3) to improve the performance and operational capability of the STS and (4) to provide a data base for studies of future aeronautical and aerospace vehicles The design, development calibration and demonstration of the Shuttle Entry Air Data System will be accomplished through in-house (LaRC) analysis and test programs and contracted studies A retrofitted instrumented nose cap incorporating the Shuttle Entry Air Data System, will obtain flight data which when reduced will produce the required air data parameter for each orbiter flight These data in conjunction with inertial data development flight instrumentation data, and data obtained by specialized instrumentation packages will be utilized to verify aerodynamics and aerothermodynamics performance as well as resolve many fluid mechanic questions

W81-70273 **506-63-34**
Langley Research Center Hampton Va
SHUTTLE INFRARED LEESIDE TEMPERATURE SENSING (SILTS)
J C Dunavant 804-827-3984
(506-51-13)

To extend the knowledge of the basic aerothermodynamics of leeside flow fields and heat transfer on large lifting vehicles into flow regimes which are inaccessible to investigations in ground facilities through sensing of leeside surface temperatures during Shuttle Orbiter entry with an infrared scanner These data will permit development of improved leeside flow field and heat-transfer prediction techniques which are required to reduce considerably the weight and cost of thermal protection systems on the leeside of future space vehicles This experiment utilizes a highly developed infrared scanner and recording system which will be qualified for the severe ascent environment in a development program at the Langley Research Center The instrumentation and supporting equipment will be installed in a Langley manufactured engineering test model and tested at the Langley Research Center the flight structural pod, exclusive of the dome will be manufactured by the shuttle orbiter contractor and the experiments will be installed in Orbiter 102 at KSC The SILTS experiment will be flown on a number of early orbiter flights

W81-70274 **506-63-35**
Ames Research Center Moffett Field Calif
INFRARED IMAGERY OF SHUTTLE
B L Swenson 415-965-5263

The purpose of this RTOP is to design develop and conduct an experiment to be used in conjunction with the first orbital flights of Shuttle The experiment is part of the Orbiter Experiments program (OEX) and will obtain measurements of surface temperature of the lower and side surfaces of Orbiter by means of remote high resolution infrared imagery This imagery is obtained on board the C-141 Kuiper Airborne Observatory (KAO) The experimental equipment to be developed consists of an acquisition telescope and appropriate servo system cryogenically cooled focal plane and detector array and a data handling and storage system

W81-70275 **506-63-36**
Ames Research Center Moffett Field Calif
OEX THERMAL PROTECTION EXPERIMENTS
H K Larson 415-965-5369
(506-53-31 506-51-31)

The overall objective of these experiments is to obtain a better understanding of Thermal Protection System (TPS) reentry heating effects that may permit TPS cost and weight reductions for Shuttle advanced Space Transportation Systems Five separate experiments will be flown as test panels or tiles replacing baseline TPS on the Shuttle Orbiter during Orbiter Flight Tests (OFT) and operational flights These experiments will take advantage of the real entry heating environment that cannot be fully simulated in ground facilities to demonstrate advanced TPS materials for possible Orbiter retrofit and to investigate TPS heating effects Temperature data will be obtained with existing and follow-on Orbiter instrumentation Baseline TPS procedures and tooling will be used and none of the experiments will impact orbiter operations The experiment will be designed and fabricated by both in-house and contract efforts and experiments hardware will be provided as GFE

W81-70276 **506-63-37**
Langley Research Center Hampton Va
SHUTTLE UPPER ATMOSPHERIC MASS SPECTROMETER (SUMS)
R C Blanchard 804-827-3786
(506-51-13 506-51-33)

The primary technological objective is to provide flight data for advances in the prediction of aerodynamic behavior throughout the high speed flight regime including the free molecular flow and the transition into the hypersonic continuum This objective will be achieved through Shuttle Orbiter flight instrumentation including a Shuttle Upper Atmospheric Mass Spectrometer (SUMS) The specific objective of the SUMS system is to provide in-situ high altitude atmospheric data primarily neutral atmospheric mass density A spare Viking flight-qualified mass spectrometer will be modified to provide atmospheric data in the high hypersonic flight regime These data coupled with data from other proposed experiment systems will provide aerodynamic information on a winged entry vehicle in flight regimes heretofore unobtainable and will augment ground-based test facilities In addition experiment results on the Shuttle will provide a benchmark from which to evaluate additional entry technology research The design construction and system tests of the prototype Shuttle Upper Atmosphere Mass Spectrometer (SUMS) and the supporting analysis on the SUMS system design and implementation will bring the experiment to the flight readiness state

Systems Technology Programs

Space Systems Studies

W81-70277 **540-01-13**
Langley Research Center, Hampton Va
INFORMATION SYSTEMS FOR EARTH OBSERVATIONS FOR SPACE
L S Keafer 804-827-3666
(506-62-63)

The objective of this RTOP is to identify technology needs and to recommend and plan associated technology developments for information systems applied in Earth observations from space Close cooperation between space applications managers and technologists is required in order to focus on the technology development issues critical to a responsive OAST research plan This work builds on the technology assessment of an advanced tropospheric observation system performed in FY-80 and culminates in specific research plans being recommended to OAST in the critical areas of Earth observation sensors and data management technology The mission design activities will be performed in-house at LaRC while the sensor workshop and research planning activities involve intercenter university and industry cooperation and require major contractual support

W81-70278 **540-01-15**
Jet Propulsion Laboratory, Pasadena Calif
SPACE MISSION UPLINK PROCESS CONTROL ARCHITECTURE
Terry D Linick 213-354-3161
(506-54-75 541-01-16 506-61-55)

The objective of this task is to develop a top level systems architecture for the uplink process control (often called sequencing) of deep space missions which will decrease operating costs and improve system responsiveness The results will be used to make incremental improvements to existing uplink systems as well as to provide a new architecture for future space missions The high cost and complexity of uplink process control systems on recent deep space missions (e g Voyager and Viking) strongly indicates the need for substantial performance and cost improvements and suggests that there is a high potential for obtaining such improvements The basic approach consists of three closely coordinated related activities (1) an analysis of past and current flight projects to determine which characteristics of uplink process control significantly impact system responsiveness and cost and to suggest how these factors can be modified to improve system performance and efficiency (2) a top-down functional analysis (TDFA) to provide a complete and systematic identification of the basic structure and characteristics of efficient uplink process control this approach will have the substantial advantage of being unconstrained by the structure of previously existing uplink process control systems and is therefore the complement of the analysis of past and current flight projects and (3) design of a new multi-mission oriented uplink architecture based upon the new views provided by the TDFA and the lessons learned from the historical analysis of flight projects The analysis of existing systems is targeted for completion in the second quarter of FY-81 The definition of the new architecture for uplink process control will be available by the end of FY-82

W81-70279 **540-01-16**
Goddard Space Flight Center Greenbelt Md
GROUND DATA PROCESSING TECHNOLOGY OPTIONS ASSESSMENT FOR MISSIONS OF THE 1985-1990 TIME FRAME
J J Gitelman 301-344-7889

Previous history in NASA research and development and operational missions has shown that these systems were designed from space looking down i e design a space sensor that produces data get these data to the experimenters/users and finally attack the problem of translating these data to the information products required This RTOP will lead to a ground up design process for new missions of the 1985 to 1990 time frame i e define the information products that are required and then design the space and ground data/information delivery system to obtain and produce the data/information necessary to derive the final information products New technological approaches and techniques to efficiently perform the data to information conversion and data dissemination will be identified The historical design from space looking down for NASA research and operational missions has generally caused a data bottleneck at the data dissemination and data analysis facilities Some of the data are never converted to information while the data to information product process is a slow one when it does occur With the coming of the Shuttle and the TDRS era the potential for total data bandwidth is overwhelming

W81-70280 **540-02-11**
Ames Research Center Moffett Field Calif
SPACE SYSTEM STUDIES - INFORMATION AND SPACECRAFT SYSTEMS
J P Murphy 415-965-6549
(506-61-31 506-61-41 358-41-06)

The objectives of this RTOP are to identify and evaluate the technology requirements of advanced system candidates, investigate future space mission alternatives, assess the effects of technology advances, and provide a data base to support technology program selection and program planning The approach is to conduct studies related to these objectives on potential mission concepts identified by OSS in Infrared Astronomy and Planetary Probes In FY-81 work will be completed on the large ambient deployable IR telescope

W81-70281 **540-02-12**
Lewis Research Center Cleveland Ohio
SPACE PROPULSION AND POWER SYSTEM STUDIES
Thomas H Cochran 216-433-6897
(506-55-32 506-52-12 506-55-22 506-55-72)

The overall objectives are to identify the propulsion and power technologies which will enable or enhance future space missions to identify the propulsion and power requirements for these future missions to define the characteristics of systems which would contain advanced propulsion and power technology and thereby to determine the critical technology advances Propulsion concepts which range from (and include) electric and chemical for orbit-to-orbit transportation and on-orbit control of spacecraft will be studied Space power concepts for propulsion and spacecraft applications will be studied with emphasis in the areas of power generation, distribution transmission energy storage and thermal management Emphasis will be placed on missions which are based on Large Space System Technology (LSST) because of the high technology challenge and the extensive technology interactions inherent in this class of missions The effort will be coordinated with work at DOD and at other centers, especially the LSST Project Office at LaRC, and will thereby provide for the planning of OAST s research and technology programs

W81-70282 **540-02-15**
Jet Propulsion Laboratory Pasadena Calif
FAR OUTER PLANETS SPACECRAFT TECHNOLOGY DEFINITION
M I Cruz 213-354-5109
(540-01-15 540-01-15 540-01-15)

In ten years a mission opportunity period will begin for a coordinated exploration of the far outer planets (Saturn Uranus, Neptune and Pluto) utilizing the Jupiter gravity assist to deliver meaningful payloads to these difficult targets Even with this advantage the design challenge is severe and new technology will be essential to accomplishing the objectives In addition a direct mission to orbit Saturn and send probes to Titan and into Saturn s atmosphere is planned for the late 1980 s The technology for this mission is equally challenging In a highly integrated study with a project definition companion study which JPL will perform for code SL and with the on-going SL Saturn orbiter dual probe study (Cronos) this task will accomplish the following objectives (1) determine applicability of advanced technology by integrating new technology based capabilities into spacecraft and spacecraft/ground systems designs (2) develop plans (performance schedule and cost) for the enabling advanced technology to implement the defined project and identify new technology development requirements (3) develop performance and technology guidelines for the development of the 1990 s spacecraft ground downlink capability to support these 1990 s missions and (4) investigate concepts for an advanced scientific spacecraft system for the outer planets missions as a departure from the traditional three axis Mariner class spacecraft

W81-70283 **540-02-19**
Marshall Space Flight Center Huntsville, Ala
SPACE APPLICATIONS OF AUTOMATION, ROBOTICS AND MACHINE INTELLIGENCE SYSTEMS (ARAMIS)
Georg vonTiesenhausen 205-453-2789

The study provides a cross-cut between major functional elements of representative future NASA mission models and available and expected options of automation robotics and machine intelligence systems which would be applied to these functional elements Required RDT&E investments costs of soft and hardware, and systems integration cost will be determined as well as cost benefits obtained over using conventional systems This is an overall systems approach to the role of advanced automation technology application in NASA s future missions

W81-70284 **540-03-13**
Langley Research Center Hampton Va
TECHNOLOGY REQUIREMENTS OF FUTURE INTEGRATED SPACE TRANSPORTATION SYSTEMS
J P Arrington 804-827-3911

The objective of this study is to identify and evaluate the technology required for the design and operation of advanced systems capable of meeting the goals of economical transportation within the Earth-Moon sphere of influence in the postshuttle timeframe The intent is to analyze potentially attractive concepts which build upon the technology base developed for the Space Shuttle Program utilizing projected advances in the areas of materials structural design propulsion aerothermodynamics, design interaction and others Definition of approaches to advanced system design and a detailed examination of the relative impact of assumptions as to achievable levels of various technologies offer a suitable means of identifying those technologies which are crucial as well as those most cost effective this identification will be a primary output of the effort An inherent characteristic of any such advanced system is that it offers clear and significant cost/capability advantages relative to current systems Programs to provide solutions to key technology issues will be designed based on the results of these studies The activity will be pursued through a series of contractual system studies, technology planning methodology-development studies and selected in-house analyses and an intercenter working group as required

W81-70285 **540-03-19**
Marshall Space Flight Center Huntsville Ala
SHUTTLE DERIVED VEHICLE TECHNOLOGY REQUIREMENTS
M A Page 205-453-3425

The objectives of this effort are to identify and define technology requirements for shuttle derived launch vehicles to establish priority schedule and funding and to determine economic leverages of technologies A contract will be solicited on competitive basis for the study The study effort will extend over eighteen months and can be conducted in two phases of nine months duration each with incremental funding after Phase 1 Phase 1 will consist of the basic vehicle configurations and requirements to identify and scope the technology that will be applicable to launch vehicles in general Parametric trades will be conducted to establish the relationship of various degrees of technology The second phase of the study will apply the trends established and information obtained in Phase 1 on general launch vehicles to the conceptual design of a selected typical launch vehicle to the depth required to drive out technology and to establish priorities, schedules implementation plans, cost benefits and leverages technology program costs, etc

W81-70286 **540-04-10**
National Aeronautics and Space Administration Washington D C
SPACE SYSTEMS AND PLANNING ANALYSIS
Stanley R Sadin 202-755-2403

The objective of this RTOP is to provide space program planning studies in support of OAST space technology program requirements assessments planning and advocacy The studies are intended to provide an analytical basis for planning activities in space R&T Areas of work will include technology status and trends assessments mission concepts and systems long range planning activities program technology needs requirements and opportunities The major focus of this activity is the NASA Space Systems Technology Model, including its completion and maintenance

Information Systems Technology

W81-70287 **541-02-12**
Lewis Research Center Cleveland Ohio
SATELLITE COMMUNICATIONS TECHNOLOGY
R E Alexovich 216-433-6689
(506-61-32 506-54-42 650-60-20)

The objective is to provide through research design and experimental tests the components subsystems and enabling technology required to support OSTA s new emphasis in satellite communications systems To achieve this objective advanced research and development programs will be conducted to identify produce and demonstrate critical components techniques, and subsystems required for complete communications systems Principal emphasis will be directed toward spacecraft microwave electron beam amplifiers with increased power output efficiency and high frequency capability multifrequency multibeam antennas providing increased frequency reuse and solid state materials and component technology for high frequency spacecraft applications such as switching power conditioning and beam forming Technology necessary for low cost earth terminals and for intersatellite data links will also be developed

W81-70288 **541-02-15**
Jet Propulsion Laboratory Pasadena Calif
EARTH SATELLITE COMMUNICATION ANTENNA DEVELOPMENT
W J Weber 213-354-3845
(506-61-25)

The objective of this RTOP is to develop the RF portion of antenna technology necessary for demonstrating the service and technology of the land mobile satellite service (LMSS) system operating within the 806 to 890 MHz band The LMSS system is a key element of the NASA narrowband program that provides low cost communications services to the user One of the possible LMSS system configurations is the recently Joint U S / Canada communications satellite project A demonstration of the service and technology of the LMSS system is planned for the 1987 time frame using the concept of contiguous multiple antenna beams It is therefore critical that necessary antenna studies be accomplished by the end of FY-82 Consequently during FY-81 and Fy-82 proof-of-concept technologies for the antenna subsystem will be developed and tested so as to reduce the risks for the demonstration project These technologies include multibeam offset reflector antenna and feed designs analytical techniques for predicting the effects on radiation patterns due to reflector surface distortions and feed position errors, efficient techniques for characterizing multibeam antennas and mobile antenna designs Lens and phased array antennas will also be investigated as possible alternatives to reflector antennas

Spacecraft Systems Technology

W81-70289 **542-03-01**
Jet Propulsion Laboratory Pasadena, Calif
DEVELOPMENT OF A SHUTTLE FLIGHT EXPERIMENT DROP DYNAMICS MODULE
T G Wang 213-354-6331

The principal objective of this RTOP is to design, fabricate and test an acoustic positioning and manipulation module for Spacelab and to utilize it to perform the experiment Dynamics of Rotating and Oscillating Drops as part of the NASA Physics and Chemistry in Space Program on early Shuttle/Spacelab flight The module is scheduled to be ready for the ESA-NASA joint Spacelab mission, and will be available for Spacelab flights thereafter This acoustic positioning and manipulation module will allow us to utilize the unique zero-g environment provided by a Shuttle/Spacelab flight to perform drop dynamics experiments that are impossible to perform in a gravitational field Examples are to study experimentally the problems first proposed by Newton -- and never satisfactorily studied -- of equilibrium figures and the bifurcation processes of a rotating spheroid and to understand the fission and fusion processes in drops that are also applicable to meteorology and nuclear physics The scope of this work is threefold (1) to determine the maximum capability of this facility within the constraints of money and schedule through consultation with the scientific community and investigators (2)

to fabricate a flight unit and (3) to perform the experiment 'Dynamics of Rotating and Oscillating Drops' as part of the NASA Physics and Chemistry in Space Program The scientific community will be invited to participate in experiments informally through international symposia and colloquia Some scientists will participate with JPL as science associates and consultants

W81-70290 **542-03-04**
Marshall Space Flight Center, Huntsville, Ala
SHUTTLE OPERATIONAL FLIGHT TEST OF THE SOLAR ELECTRIC PROPULSION SOLAR ARRAY
Rein Ise 205-453-2163
(506-23-19)

The objective of this RTOP is to provide overall demonstration of the availability of advanced solar array technology by flight testing the Solar Electric Propulsion (SEP) Solar Array as an experiment on the Shuttle Demonstrating that the array will deploy and retract in a space environment and establishing its dynamic characteristics are objectives which are particularly important The approach consists of four basic steps as follows (1) define through study and analysis the requirements criteria and conceptual design for the solar array experiment system (2) perform a detailed design build and test the flight array experiment (3) install and fly the solar array experiment on Shuttle and (4) evaluate flight results after return to Earth

W81-70291 **542-03-13**
Jet Propulsion Laboratory Pasadena Calif
SPACELAB 2 SUPERFLUID HELIUM EXPERIMENT
G Lagomarsini 213-354-5110

An experiment to investigate the properties of superfluid helium in zero gravity is planned for flight on Spacelab 2 in early 1983 The experiment will determine the mechanical and thermal properties of superfluid helium in sufficient detail to enable the design of high performance space qualified superfluid cryogen systems A companion experiment will study the properties of low velocity capillary waves in thin films of superfluid helium These waves cannot be observed in the Earth s gravity Their study will increase scientific understanding of the interaction of normal and superfluid helium The experiment will consist of an instrumented cryostat an experiment package mounted inside the cryostat, and an electronics control and data processing electronics package It will be mounted on a Spacelab pallet and will interface with the Spacelab Command and Data Management System Interactive control with experimenters on the ground will permit optimization of scientific results by real time modification of experimental conditions and parameters

W81-70292 **542-03-20**
Jet Propulsion Laboratory Pasadena Calif
SPACE CALIBRATION OF SOLAR CELLS
Louis B Sidwell 213-354-5489
(506-55-45)

The objective of this RTOP is to take advantage of the space environment of Spacelab to correlate solar cell calibration data with those obtained from balloon flights The Spacelab program will provide the opportunity to validate existing calibration procedures and to determine the most cost effective way of accomplishing solar cell calibration During FY-81 support will be provided to the pre-integration and integration activities for the proposed May FY-82 flight of the Solar Cell Calibration Facility (SCCF) Retesting (system and environmental) to insure flight readiness will be accomplished prior to shipping the SCCF to the integration site Candidate test solar cell specimens will be selected in advance of the Spacelab flight with similar solar cells to be flown on a high altitude balloon flight calibration experiment for comparative analysis The RT funded balloon flight will take place during the same time frame as the Spacelab flight On completion of both flights the RT funded data reduction will begin with completion and final report expected 180 days after data availability

W81-70293 **542-03-27**
Marshall Space Flight Center Huntsville Ala
TRIBOLOGICAL EXPERIMENTS IN ZERO GRAVITY
R L Gause 205-453-1500

The experiment Tribological Studies of Fluid Lubricated Journal Bearings in Zero Gravity proposes the operation of a conventional journal bearing and of a journal bearing which utilizes ferrolubricants Basic behavior characteristics of journal bearings operating in zero gravity should be provided by this experiment The experiment Wetting, Spreading, and Operating Characteristics of Bearing Lubricants in a Zero Gravity Environment, will monitor the wetting process for selected lubricant surface combinations and provide an understanding of the mechanism of properly maintaining lubricant films and the effect of surface wettability on bearing performance and life in a space environment

W81-70294 **542-03-30**
Langley Research Center Hampton Va
SEMICONDUCTOR MATERIALS GROWTH IN LOW-G ENVIRONMENT
R K Crouch 804-827-3661
(179-80-10 506-54-43)

The objective is to utilize the microgravity environment available on the Space Shuttle in such a way as to eliminate or minimize the segregation of constituents by minimizing the influence of thermal convection on the growth of semiconductor materials usable in making infrared detectors and tunable diode lasers Studies in a 1-g environment will optimize growth procedures and analysis will include detailed comparison of space-grown and Earth grown crystals to provide data on important growth parameters needed to improve state-of-the-art Earth based processing

W81-70295 **542-03-52**
Lewis Research Center Cleveland Ohio
CRYOGENIC FLUID MANAGEMENT
Thomas H Cochran 216-433-6897
(506-52-12)

A Shuttle Spacelab flight experiment to obtain data on the storage and supply of subcritical cryogenic fluids in a low-g environment will be designed

W81-70296 **542-04-13**
Langley Research Center Hampton Va
LONG DURATION EXPOSURE FACILITY
R D English 804-827-3704

The broad LDEF Project objectives are the following (1) to develop the Long Duration Exposure Facility (LDEF) (2) to develop and perform a first set of experiments on the LDEF and (3) to broaden the operational STS user community The LDEF a shuttle transported, reusable unmanned low cost free flying structure on which many different experiments can be mounted will be developed and manufactured in house at Langley The experiments many of which are completely passive with active data measurements being made in the laboratory after recovery will be solicited from all NASA Centers, other government agencies industry, and foreign countries The STS user community will be broadened by the LDEF providing a unique simple low cost approach to perform large numbers of needed long duration technology and science experiments The establishment of a continuing program to provide for LDEF reflights after the first LDEF mission with the operational STS is a part of this RTOP

W81-70297 **542-05-12**
Lewis Research Center, Cleveland Ohio
FLIGHT TEST OF AN ION AUXILIARY PROPULSION SYSTEM (IAPS)
Rodney M Knight 216-433-5183
(506-62-32)

The objectives of this RTOP are to conduct in-situ tests of a one millipound mercury ion thruster auxiliary propulsion system over a representative duty cycle and time period to acquire engineering design information by which to determine the systems compatibility with host spacecraft to demonstrate to potential users the technology readiness of mercury ion thruster systems for auxiliary propulsion applications aboard operational spacecraft and to fly the experiment as part of the USAF/Space Test Project P80-1 (Teal Ruby) spacecraft

Energy Programs
Space Utilization Systems

W81-70298 **775-16-27**
Lyndon B Johnson Space Center Houston Tex
IN-SITU INSTRUMENTATION FOR DEVELOPING NUCLEAR WASTE ISOLATION SITES
J E Keith 713-483-5840

DOE in-situ tests to study the migration of nuclear wastes over tens of meters in various geological settings will begin soon Such field tests will require several years to complete The objective of NASA investigations carried out under this RTOP will be to develop and optimize instrumentation and data collection and analysis techniques to sense this migration while it is in progress without compromising the experiment A theoretical model of the interactions of neutrons with geological materials will be built based upon a neutron transport code detector response functions and previous experience with similar instruments A laboratory mockup consisting of a neutron source detectors and a large mass of geologic material capable of being instrumented with neutron foils will be built This mockup will be operated to improve and validate the theoretical model and to discover the optimum operating conditions for information recovery A breadboard field test unit will be assembled using the results of the laboratory tests and where possible parts from the mockup and field demonstration tests performed

Solar Energy Systems

W81-70299 **776-91-17**
Lyndon B Johnson Space Center Houston, Tex
REGENERATIVE FUEL CELL/ELECTROLYSIS CELL-HYDROGEN/HALOGEN
David Bell, III 713-483-6491

The objective of this research effort is to advance the hydrogen/halogen fuel cell and electrolysis cell technology to maturity and to demonstrate suitability to large energy conversion and storage requirements for high power long life life systems A data base will be developed using a hydrogen/bromine 5 to 7 kW sized unit test An engineering model will be fabricated and delivered for field demonstration A data base will be developed to assess its potential to meet the bulk energy storage needs of future NASA and DOE programs

W81-70300 **776-91-19**
Marshall Space Flight Center Huntsville Ala
INTEGRATED MODULAR SOLAR ENERGY SYSTEMS (SMALL DISPERSED SOLAR ENERGY SYSTEMS APPLICATIONS)
W F Richardson 205-453-1746

The objectives of this RTOP are to select the most feasible solar energy system conceptual designs developed in FY-80 and to initiate the detailed designs and integration of those systems, and to prepare program planning documentation appropriate for a NASA program responsibility of supporting other U S Government Agencies in development and demonstration of those systems The general approach will be to use the data and other information now being developed to generate the technical and managerial information requisite to preparation of procurement documents for the project implementation phase to follow The method will be to use a time phased continuation of the present study to maintain and amplify the knowledge and skills gained during the first phase

W81-70301 **776-91-35**
Jet Propulsion Laboratory Pasadena Calif
STUDIES IN BIOENERGY
R H Green 213-577-9591

The objective of this RTOP is to perform the appropriate studies planning and technical verification tasks necessary to demonstrate the merit of NASA involvement in bioenergy The NASA experience and expertise in biomass related technologies will be evaluated to identify develop, and demonstrate advanced biomass energy delivery systems The results of this work will provide the recommendations and supportive data necessary to determine the potential for an institutional role in the execution of the national bioenergy program The above objectives will be achieved through the following approach with Jet Propulsion Laboratory serving as lead organization and responsible for coordination of the RTOP (1) focus and refine the emerging biotechnology base and identify NASA center capabilities and roles through the selection and initiation of verification and demonstration tasks (2) complete the multi-year NASA Bioenergy Plan to identify the potential NASA role and technology focus and (3) prepare a bioenergy mission analysis, a preliminary implementation plan and select specific bioenergy delivery systems for further analysis and demonstration in FY-82

W81-70302 **776-91-40**
Marshall Space Flight Center Huntsville Ala
OCEAN THERMAL ENERGY CONVERSION STUDY AND ASSESSMENT
C R Ellsworth 205-453-1333

The objectives are (1) to investigate the program factors common to the Ocean Thermal Energy Conversion (OTEC) Program and NASA s developed capabilities (2) to determine the most feasible options for applying NASA s capabilities and resources to support the OTEC Program (3) to develop appropriate planning documents illustrating the findings and results of the study and (4) to define proposed options for NASA s role in support of the OTEC Program The approach will be to review the existing and projected OTEC plans compare this information with past and present NASA programs involving large hardware integration activities and identify the skills facilities and programmatic interfaces of a potential OTEC mission for NASA Typical MSFC capabilities applicable to OTEC development include materials research and test structural dynamic analyses and test instrumentation and control analyses and design and power distribution analyses and design

W81-70303 **776-91-59**
Marshall Space Flight Center Huntsville Ala
SOLAR RANKINE CYCLE APPLICATIONS STUDY
W F Richardson 205-453-1746

This RTOP aims to determine the feasibility of increasing the size of solar Rankine devices to develop 200-1200 horsepower and/or generate electrical power in Megawatt capacities Study results will indicate technical feasibility of such devices design criteria and critical factors involved in the development phase Trade studies and feasibility analyses will be performed using existing technology and available performance data on solar Rankine cycle devices Assessments of the thermal range between 150F to 600F will be employed to determine feasibility of using low and high-grade process heat to provide the thermal energy for the Rankine cycle working fluids Various working fluids will be assessed to select those for the thermal range in question Various turbine and nozzle designs will be studied to obtain maximum performance of the Rankine unit Analysis and performance mapping of power generation capabilities over the thermal range will be developed

Conservation and Fossil Energy

W81-70304 **778-45-12**
Lewis Research Center Cleveland Ohio
COMBUSTION TECHNOLOGY FOR POWER GENERATION
D A Petrash 216-433-6860

The objectives of this work are to identify and verify NASA Lewis Research Center s aeronautical and space related combustion technologies for application to selected combustion needs of DOE and other organizations These objectives will be attained through experimental studies to demonstrate technical feasibility of combustion concepts for energy projects, analysis of combustion designs for different applications and design studies to determine the need requirements approach, etc The work will include (1) experimentally determining the potential

advantages of using steam-assisted fuel injection in premixing fuel preparation systems for use in stationary gas turbine power plants (2) evaluating catalytic combustion with and without steam injection for stationary gas turbines and (3) preparing reimbursable combustion technology plans as may be required

W81-70305 **778-45-35**
Jet Propulsion Laboratory Pasadena Calif
ENERGY PLANNING SUPPORT AT JPL
G E Nichols, Jr 213-577-9141

The objective of this RTOP is to support the initial problem definition and the subsequent preparation of approach papers, preliminary project plans etc , for activities in the area of energy conversion systems

W81-70306 **778-46-12**
Lewis Research Center Cleveland Ohio
POWER GENERATION CONCEPTS AND APPLICATIONS
L I Shure 216-433-4000

This effort will identify and evaluate national needs with respect to stationary power generation that can be solved by use or application of NASA s existing technology developed from aerospace programs in power and propulsion Particular emphasis will be given to cogeneration applications This will be accomplished through (1) the improved analysis capability and the analytical screening of advanced concepts for potential application to stationary power with emphasis on cogeneration (2) evaluation of advanced components and technologies applicable to advanced systems in a real environment and (3) preparation of energy research and technology plans proposed for implementation by DOE on a reimbursable basis that are responsive to their projected needs

W81-70307 **778-46-22**
Lewis Research Center Cleveland Ohio
STIRLING ENGINE COMPONENTS AND SYSTEM CONCEPTS
Donald G Beremand 216-433-4331

The purpose of this activity is to build upon the current Lewis Research Center capabilities and programs in Stirling engines to examine the Stirling engine in a broader way to evaluate opportunities and to derive its potential benefits of high efficiency low exhaust emissions, low noise, and broad multifuel capabilities for other applications This expertise will be applied to the development of reimbursable Stirling technology programs The Stirling engine technology base will be broadened through in-house and contractual efforts that are complementary to established reimbursable programs Early efforts will concentrate on acquiring a broad understanding in the areas of (1) determining the engine requirements and identifying the potential of the Stirling engine for a broad range of engine applications (2) acquiring experimental Stirling engine experience from a free piston 13 kW research engine with varied output load capability (including hydraulic output) (3) generating validated computer codes for predicting free piston Stirling engine performance (4) comparing alternate Stirling engines (free piston or kinematic single or modular engines) and (5) experimentally investigating component and subsystem technology within critical areas

W81-70308 **778-46-35**
Jet Propulsion Laboratory Pasadena Calif
VALIDATION OF STIRLING LAB ENGINE
G W Meisenholder 213-577-9148

The overall objective of this RTOP is to establish a coordinated NASA/University Stirling Engine Research activity Specifically this effort is designed to stimulate research relative to Stirling cycle machines with the goal of broadening the technology base within the United States NASA has significant Stirling development programs underway in advanced automotive propulsion and solar thermal electric systems Stationary Stirling engines one of the most promising applications are in the conceptual stages at DOE A underlying problem behind all this activity is however, that with a few isolated exceptions, the technology base supporting these major commitments is held by a small number of foreign corporations There is practically no on-going basic research or research and development base in the U S This shortcoming was one of the major themes in the First Annual Report to Congress on the Automotive Technology Development Program by DOE (Aug 1979) Previous NASA RTOPs at JPL have produced an operational preprototype Stirling Laboratory Research Engine (SLRE) The approach for FY-81 consists of the following (1) conduct a JPL fundamental research experiment in transient heat transfer and fluid flow (2) secure follow on support to the Stirling analytical modeling work of Dr Michael J Meurer Cal State LA All of the steps outlined will be supported as necessary with the JPL SLRE

W81-70309 **778-47-15**
Jet Propulsion Laboratory Pasadena Calif
ADVANCED COAL PROCESSING CONCEPTS
R L Phen 213-354-9145

The general objectives of this RTOP are to identify and verify new coal processing technologies that meet national needs for reduced costs of coal liquefaction and coal beneficiation while concurrently improving environmental characteristics of the resultant fuels The two main elements composing this activity are (1) Coal liquefaction technology and (2) coal beneficiation technology Each technology area will be directed by a study which will define the requirements and applications of the technology The objectives of coal liquefaction technology will have the following tasks (1) To conduct a study to determine the outlook for synthetic liquids and a role for NASA/JPL in coal liquefaction on a national level and (2) to undertake critical coal liquefaction experiments in available test facilities on the following concepts (1) single step catalytic conversion to middle distillates (2) auto-catalytic conversion to distillate oils and (3) liquefaction in the high shear environment of a coal extruder The coal liquefaction study will include assessment of liquefaction requirements applicable technologies and the present roles of organizations conducting coal liquefaction system development to establish future liquefaction development needs and potential roles for NAS/JPL Liquefaction tests will be carried out in the existing reactors The technical feasibility of the three liquefaction concepts will be evaluated using test data

W81-70310 **778-47-29**
Marshall Space Flight Center Huntsville Ala
COAL CONVERSION PROCESSES AND SYSTEMS
C R Ellsworth 205-453-1333
(778-50-29)

The general objective of this RTOP is to acquire an in-depth center knowledge and expertise in coal conversion systems whereby a creditable proposal for technology or demonstration related advancement can be submitted to the DOE TVA or other energy related agencies offering reimbursable support responsive to their projected needs This RTOP consists of the following tasks (1) Applications for Second and Third Generation Coal Gasifier Systems (2) Coal liquefaction systems technology assessment, and (3) Alternate fuel products from low/medium BTU coal gas These tasks will consist of studies to develop background information and requirements for the several applications These tasks will directly support the definition of a reimbursable project plan

W81-70311 **778-48-15**
Jet Propulsion Laboratory Pasadena Calif
CONCEPTS FOR IMPROVED GROUND TRANSPORTATION SYSTEMS
G W Meisenholder 213-354-9170

The overall objective of this RTOP is the utilization of NASA system capabilities and communications and control technology in the area of Transportation Flow Management (TFM) to contribute to the critical national need for petroleum conservation Studies conducted as part of current work for DOT JPL in-house efforts and the related FY80 RTOP have shown TFM to have potential for producing significant savings in petroleum fuel with attendant benefits of emissions reduction and travel time savings

These efforts have also identified potential TFM applications for NASA technology and capabilities Additional investigation and analysis is needed to better define requirements and benefits identify an appropriate role for NASA and develop a program plan for implementation of that role The approach to achieving the above objective will be to (1) complete the investigation of TFM requirements initiated under the FY80 RTOP (2) utilize results of relevant studies to assess the benefits of selected TFM examples and extend these to aggragate national level benefit (3) compare identified needs and benefits with NASA capabilities and technology to develop a rationale for NASA involvement in TFM (4) develop an appropriate TFM role for NASA and a program plan for its implementation

W81-70312 **778-48-17**
Lyndon B Johnson Space Center Houston Tex
WASTE HEAT AUTOMOTIVE AIR CONDITIONER
R R Richard 713-483-2497
(506-25-27)

Current research at the University of Texas at Austin has demonstrated a nonmechanical cryogenic refrigeration system capable of producing cooling at liquid nitrogen temperatures The Molecular Adsorption Refrigeration System (MARS) employs an adsorption pumping concept similar to that used by the Servel Principle utilizing zeolite crystals (also called molecular sieves) for gas storage and subsequent pressurization through the application of heat The capability to use heat energy for the refrigeration cycle makes it ideal for adaptation to automotive air conditioning and other applications wherein waste engine heat may be used as the primary source of power The proposed effort will determine the optimal means of adapting the MARS technology to these consumer oriented energy conserving applications

W81-70313 **778-49-15**
Jet Propulsion Laboratory Pasadena Calif
INDUSTRIAL CONSERVATION, COGENERATION AND UTILIZATION OF ALTERNATIVE FUELS
Y Nakamura 213-577-9247

The objectives of this RTOP are to assess the energy conservation potential in the application of NASA-developed technology and technology spin-offs to industrial processes Specific objectives of the two proposed tasks are (1) Direct Contact Heat Exchanger for Caustic Flowstreams Demonstration and improved process for heat exchanger performance that will allos recovery of waste heat presently lost in caustic flowstream (2) Automation of Industrial Processes Determine the energy conservation potential in the application of advanced sensor automation data acquisition and processing and control technology to selected industrial processes

W81-70314 **778-50-15**
Jet Propulsion Laboratory Pasadena Calif
UTILITY POWER SUPPLY AND LOAD MANAGEMENT
E P Framan 213-354-9265

This RTOP has as its overall objective the focussing of NASA's systems capabilities control and communications disciplines and knowledge of evolving new power generation and storage technologies on the increasingly severe problems of electric utilities The RTOP also addresses a number of topics in the integration and management of new technologies and in the application of NASA developed methods to power systems expansion planning Practical tests with rigorous data acquisition and analysis are required to avoid a long repetition of demonstrations to convince the utility industry that the methods in question are practical The approach will be to (1) focus and coordinate NASA s capabilities by a continuing education program at Jet Propulsion Laboratory, involvement in professional utilities system activities, assessment of NASA s capabilities, and to coordinate and develop integration activites at the NASA centers (2) perform a variety of technology identification and verification activities applying NASA capabilities to the utilities in the cities of Burbank Glendale and Pasadena as a test site and (3) develop plans for reimbursably funded activities

W81-70315 **778-50-29**
Marshall Space Flight Center Huntsville Ala
ADVANCED ENERGY TECHNOLOGY FOR UTILITIES
C R Ellsworth 205-453-1333
(778-47-29)

The general objective of this RTOP is to acquire an in-depth Center knowledge and expertise in Advanced Energy Conversion Systems whereby creditable proposals related to large scale field demonstration programs can be submitted to the DOE TVA or other energy related agencies offering reimbursable support responsive to their projected needs This RTOP consists of the following task (1) Advanced power generation systems technology studies for electric utility applications to include fuel cells combined cycle gas turbines and other innovative systems This task will consist of a study to develop and catalog status background information and application requirements for several power generation systems This task will directly support the definition of a reimbursable project plan

OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS

Technology Utilization-Identification and Dissemination

W81-70316 **141-20-11**
Hugh L Dryden Flight Research Center Edwards Calif
AERODYNAMICS OF GROUND VEHICLES
T R Sisk 805-258-3311

The overall objective of this RTOP is to improve the efficiency and effectiveness of ground vehicles through (1) improved external aerodynamics efficiency (2) improved ingestion efficiency for cooling and ventilation and (3) definition of traffic interference effects Aerodynamic principles successfully applied to aircraft shapes will be employed using the coast-down techniques hot-wire anemometry wind tunnel testing and flow visualization methods

W81-70317 **141-20-21**
Ames Research Center Moffett Field Calif
REMOTE SENSING OF SUBSURFACE DRAIN MALFUNCTIONS
J P Millard 415-965-6360

The objective of this effort is to develop a Standard Mode of Operation for identifying malfunctioning drain lines in irrigated farmlands Visible and thermal-IR techniques will be employed To accomplish this objective Ames Research Center will work with the USDA Imperial Valley Conservation Research Center Ames will fly an 11-channel multispectral scanner over test areas provided by USDA Both low and high altitude repetitive flights wil be conducted to determine optimum times of year and required frequency of measurements

W81-70318 **141-95-01**
Marshall Space Flight Center Huntsville Ala
COMMERCIAL PROTOTYPE FUSION-WELDING SYSTEM (COMPUTER CONTROLLED/CLOSED CIRCUIT TELEVISION ARC GUIDANCE)
W A Wall 205-453-4878

The objective of this RTOP is to develop and demonstrate a prototype fusion welding system suitable for technology transfer Gas tungsten arc and gas metal arc (GTA and GMA) welding will be accommodated by the prototype The basis for the prototype will be the recently developed MSFC weld skate Weld guidance will be incorporated into the prototype with a closed circuit television (CCTV) weld guidance system which was separately developed at MSFC Present equipment performance will be retained or enhanced while reducing cost via conversion from a minicomputer to a microprocessor based control system Development will be done jointly by MSFC and contractor in three phases evaluation/review of existing technology design/build GMA model (convertible to GTA) around MSFC weld skate incorporating microprocessor control and CCTV arc guidance

Demonstration (third phase) will be to commercial/aerospace and military hardware manufacturers

W81-70319 **141-95-01**
Marshall Space Flight Center Huntsville Ala
COMMERCIALIZATION AN ORBITAL TUBE FLARING SYSTEM
J R Williams 205-453-5089

The objective is to develop a prototype commercial, tube flaring machine capable of producing the precision flarings necessary for fabrication of leakproof long life tube joints The manufacturing process for producing such machines will be refined concurrently with prototype development Development of both prototype and manufacturing process will be done under contract Present MSFC developed precision tube flaring performance will be equaled or exceeded The contractor will demonstrate the developed prototype to commercial tube fabricators for sales purposes

W81-70320 **141-95-02**
Marshall Space Flight Center Huntsville Ala
PROSTHETIC URINARY SPHINCTER CONTROL VALVING SYSTEM
R Helms 205-453-5480

The objective of the project is to fabricate and test a simple reliable prosthetic urinary sphincter to enable urinary incontinent patients to achieve external voluntary control of bladder function NASA technology and expertise in valve system design and manufacturing assembly checkout and installation processes are directly applicable to the design of this system The solution was developed in response to a problem statement from the Research Triangle Institute Biomedical Applications Team The objective will be accomplished by (1) implanting a cuff or collar around the urethra which occludes the passage of urine when fully inflated without causing tissue necrosis and (2) subcutaneous implantation of the single control valve and reservoir system for inflating the cuff in the male scrotum or female labium for easy external actuation

W81-70321 **141-95-02**
Marshall Space Flight Center Huntsville Ala
OCULAR SCREENING SYSTEM
R R Jayroe 205-453-5609

The objectives of the project are to develop an ocular screening system capable of automatically and numerically defining the optical status of an individuals s pair of eyes and to define the upper limits of the diagnostic capabilities of the acquired image data The end product is a hardware design of a commercial system that can be manufactured for under $4500 and that has a false alarm threshold of 5% or less In this project the device will principally be used to screen children for incipient ophthalmologic diseases which can later result in amblyopia blindness This medical application of NASA s remote sensing technology is being supported by the Research Triangle Institute NASA Biomedical Application Team The objectives will be accomplished by (1) upgrading and evaluating the screening system utilizing calibration data (2) making the system available for use by physicians in a clinical study which provides independent evaluation (3) and comparing the screening results and physician s examination results with NASA computer image analysis for possible extension of screening procedure into a diagnostic mode

Environmental Observations Applied Research And Data Analysis

W81-70322 **146-01-00**
Jet Propulsion Laboratory Pasadena Calif
SEASAT DATA UTILIZATION PROJECT
Pat Rygh 213-354-7240

The objective will be to complete the goals of the Seasat Data Utilization Project The general objective of the Seasat Data Utilization Project is to determine the extent to which the Seasat-A serves to demonstrate the utility of microwave sensing from a satellite as an oceanographic tool as expressed by the perform-anced goals of the orginal Seasat-A Project The approach will be to continue the assessment of the SMMR and the SAR The production of global data records for the SASS and SMMR will be extended The real-time data distribution system of the commercial demonstration will be continued Publication of the evaluation results will be extended

W81-70323 **146-10-02**
Goddard Inst for Space Studies, New York
NUMERICAL CLIMATE MODELING
James Hansen 212-678-5593

Climate models are developed and applied to support NASA s role in the National Climate Program, particularly to help define requirements for observing systems Appropriate climate modeling capability is developed to conduct numerical climate experiments including climate process diagnostic studies measurement parameter sensitivity studies and observing system simulation studies

W81-70324 **146-10-03**
Goddard Space Flight Center, Greenbelt Md
CLIMATE RESEARCH
A Arking 301-344-7208
(146-10-03 146-10-02)

The aim of this RTOP is to conduct a broad based research program in support of the NASA Climate Program, including data base development special studies of climate processes, climate modeling and analysis and climate observing system development The specific approach is to (1) continue efforts to produce atlases of sea ice concentration from Nimbus 5 ESMR and radiation budget from Nimbus 6 ERB, and continue development of pilot climate data management system but defer hardware (2) complete guidelines for three special studies continue cloud radiation experiment, including preparation for CCOPE continue study of cryosphere processes and at a more modest level boundary layer processes solar-climate coupling and soil moisture transport (3) continue climate sensitivity predictability and diagnostic studies with GLAS GCM and with SDM's develop coupled atmosphere-ocean model and improved methods of parameterization of climate processes and (4) continue efforts to develop concepts for a climate observing system with emphasis on precipitation continue studies for improved radiation budget sensor and continue solar monitoring rocket flights

W81-70325 **146-10-04**
Ames Research Center Moffett Field, Calif
AEROSOL CLIMATIC EFFECTS SPECIAL STUDY
J B Pollack 415-965-5530

A coordinated set of theoretical laboratory, and field investigations of the chemistry and radiative properties of natural (e g volcanic) and man-made atmospheric aerosol particles are conducted in order to assess their impact on regional and global climate The field investigations are intended to provide complementary information on aerosols to that being obtained from spacecraft platforms (e g SAM II and SAGE) so as to insure that a comprehensive set of aerosol properties are gathered for climate analyses The theoretical and laboratory tasks are directed at interpreting and utilizing the aerosol data sets to perform the desired climate assessments The centerpiece of the field investigations is a set of coordinated aerosol measurements, which are flown together on an appropriate aircraft platform (e g U-2) When possible these flights are conducted in conjunction with spacecraft and other airborne aerosol measurements Information is obtained on both the aerosol formation mechanisms and on their radiative properties so as to enable the development of a predictive capability as well as determination of the present climatic effects of aerosols Both theoretical modeling and laboratory studies are used to further define the mechanisms of aerosol formation, to provide hypotheses that can be tested by the field investigations, and to provide ultimately the predictive tools Theoretical investigations involving radiative transfer dynamics and aerosol formation are utilized for making the climatic assessments

W81-70326 **146-10-06**
Langley Research Center Hampton, Va
RADIATION BUDGET AND AEROSOL STUDIES
James L Raper 804-827-3431
(146-10-03 146-10-02 146-10-04 146-10-03)

The objectives of this RTOP are (1) to develop and improve satellite based techniques for monitoring the spatial and temporal distributions of the Earth s radiation budget, and (2) to conduct studies of stratospheric aerosols using ground-based LIDAR techniques The objectives will be accomplished by (1) performing sensitivity studies using existing radiative transfer models to establish radiation budget measurement capabilities (2) conducting investigations using existing satellite data to provide increased understanding of the Earth s radiation budget and limitations of current measurement capabilities (3) conducting advanced mission studies consisting of flight simulations, development of sampling strategies and retical performance and methods for improving instrument accuracy and precision through use of advanced-design sources and calibration techniques (5) developing a long duration easily accessible self-consistent radiation budget data set for the conduct of present and future investigations (6) providing studies of measurement requirements and recommendations for the synthesis of the radiation budget-related portion of the climate program (7) conducting ground-based measurements of atmospheric aerosols in support of satellite aerosol experiments using the LaRC 48-inch Lidar (8) investigating instrumentation contributions to discrepancies observed in Nimbus 6 ERB nonscanner measurements and (9) performing analyses to determine the diurnal variability of cloudiness on regional scales from GOES satellite data for application to radiation budget studies

W81-70327 **146-20-08**
Goddard Space Flight Center Greenbelt Md
GLOBAL TROPOSPHERIC MODELS MONITORING
Richard W Stewart 301-344-8895
(146-20-10 146-20-09)

The aim of this RTOP is to (1) develop an understanding of tropospheric environmental problems that may be amendable to solution through the use of remotely sensed data (2) develop, evaluate and demonstrate remote sensing concepts for observing the nature and distribution of tropospheric pollution (3) demonstrate the application of remote sensing technology to the specific problem of assessing the impact of urbanization and industralization on global regional and urban air quality The approach used will be to continue development of global tropospheric models for calculation of trace species concentrations and to evaluate and develop remote sensing techniques for the detection of visible evidence of polluted air masses and for trace species measurement This RTOP supports the following major programs air quality, weather and climate These in turn support the objectives of environmental management and technology transfer

W81-70328 **146-20-10**
Langley Research Center Hampton Va
APPLICATION OF REMOTE MEASUREMENT TECHNIQUES TO TROPOSPHERIC AIR QUALITY MONITORING
F Allario 804-827-2576

The objective of the RTOP is to develop a basic understanding of those environmental problems associated with the global troposphere through a coordinated program of atmospheric modeling and measurements from satellite aircraft, and ground-based platforms Remote sensing concepts for observing the nature and distribution of tropospheric pollution will be developed evaluated, and demonstrated and the application of remote sensing technology to the specific problem of assessing the impact of urbanization and industrialization on global regional and urban air quality will be demonstrated The approach for achieving the objectives will consist of a coordinated program in (1) global tropospheric modeling (2) experiment/instrument technique development (3) laboratory studies (4) field measurement studies and (5) program implementation

W81-70329 **146-20-23**
Ames Research Center, Moffett Field Calif
THEORETICAL STUDIES OF THE UPPER TROPOSPHERIC AEROSOL LAYER AND SAHARA DUST
O B Toon 415-965-5971

A three dimensional physical-chemical model of the formation evolution and transport of tropospheric aerosols is being constructed The model will first be applied to Sahara dust storms and tested against satellite and in situ observations A one dimensional model will be used to study the chemical nucleation of aerosols in the upper troposphere A laser system is being developed and tested for aircraft measurements of trace gases such as OH and HO2 Fluoresence measurements and absorption measurements are being considered Laboratory studies of the nucleation of binary systems of atmospheric interest are being conducted At first simple binary systems will be considered to check the accuracy of theories of nucleation Later studies of gases at pressures and temperatures appropriate to the atmosphere will be made A radioactive tracer method of measuring the OH radical by measurement of the oxidation rate of CO, has been developed and successfully applied in the lower troposphere Improvements will permit its use on moving platforms Comparisons will be made with other (laser) instruments and with theoretical predictions

W81-70330 **146-30-02**
Goddard Space Flight Center Greenbelt Md
GLOBAL WEATHER RESEARCH
E A Neil 301-344-6291
(146-10-02 146-50-02)

The aim of this RTOP is to develop new and improved spaceborne remote sensing systems and collaborate with NOAA in improving the capabilities of the Operational Environmental Satellite System develop improved data processing and retrieval techniques to provide more accurate understanding of processes which influence state and behavior of the atmosphere and to utilize the capabilities of remote sensing for improving the accuracy of large-scale numerical weather forecasting Theory, numerical models laboratory measurements, and field experiments will be used to define develop and evaluate new and improved remote sensing techniques to observe profiles of atmosphere temperature moisture and pressure precipitation surface properties and atmospheric radiative properties Infrared and microwave techniques for meteorological parameter retrieval and analysis and assimilation of satellite data into numerical forecast models will be studied and their impact on the models will be assessed New and improved parameterization approaches sounding techniques analytical filtering techniques to improve forecast models will be studied

W81-70331 **146-30-02**
Marshall Space Flight Center Huntsville Ala
GLOBAL WEATHER RESEARCH
William W Vaughan 205-453-3100
(146-50-02)

The aim of this RTOP is to contribute to the NASA Global Weather Research Program objectives by performing geophysical fluid dynamics experiments and theoretical activities to develop a new and improved spaceborne sensing techniques theoretical and laboratory models and improved understanding of atmospheric behavior by contributions to the development of more realistic general circulation models The approach used will be to continue theoretical and experimental studies on potential Spacelab experiments to simulate the Earth s large-scale baroclinic atmospheric circulation examine global weather processes to gain improved understanding between various scales of motion continue to utilize satellite data to understand global atmospheric dynamic processes and investigate satellite Doppler Lidar wind system concepts

W81-70332 **146-30-03**
Langley Research Center Hampton, Va
AIRBORNE WATER VAPOR LIDAR
E V Browell 804-827-2576
(146-20-10)

An evaluation of the Airborne Differential Absorption Lidar (DIAL) System for making water vapor profile measurements in the boundary layer troposphere, and tropopause regions of the atmosphere will be completed These data will be analyzed to improve the understanding of atmospheric inhomogeneities and transport processes Three dimensional water vapor profile information will also be studied to determine the usefulness of the these data in weather forecasting Flight tests of the

Airborne DIAL system will be conducted to determine the sensitivity of the system for measuring water vapor in the free troposphere and tropopause regions of the atmosphere Lidar observations of water vapor in these and previous flight experiments will be used to improve the understanding of inhomogeneities and transport in the lower atmosphere The field measurements, data reduction and data analysis will be done jointly with the University of Maryland and the National Center for Scientific Research France

W81-70333 **146-40-05**
Langley Research Center Hampton Va
MICROSCALE OCEAN SURFACE DYNAMICS
W L Jones 804-827-3631
(146-40-13)

The objectives of this research are to provide a physically unambiguous interpretation and quantitative utilization of active microwave remote observations of ocean conditions to assess the impact of same on relevant problems in oceanography and to publish results in the referred literature The interactions between the microscale ocean surface features and electromagnetic waves as detected by active microwave sensors such as scatterometers and imaging radars will be investigated Radar signatures of the ocean as a function of geophysical conditions and data inversion algorithms for retrieval of information on ocean s dynamic characteristics and wind stress will be developed The approach taken is to establish contacts with most qualified theoretical fluid dynamicists who are able to provide assistance in the area of air sea interactions for the purpose of helping couple scatterometer data with the best models of processes at the air sea interface Contacts will be established with scientists conducting field observational programs in small scale surface structures of the air sea interface to become better acquainted with the measurement requirements and difficulties associated with research in the marine boundary layer Plan and implement airborne scatterometer missions will be planned and implemented in cooperation with these scientists For FY-81 the emphasis is in the following areas wave wave interactions delta-k radar scatterometer/air sea interactions and scatterometer hurricane research

W81-70334 **146-40-05**
Jet Propulsion Laboratory, Pasadena Calif
OCEAN WAVE HEIGHT DETERMINATION WITH THE SYNTHETIC APERTURE RADAR
Atul Jain 213-354-6614

The purpose of this work is to develop and analyze the capability of the synthetic aperture radar (SAR) to measure ocean wave heights Two possible techniques have been identified for providing this measurement which are (1) obtaining radar images utilizing small sections of the total signal bandwidth, determining the normalized average intensity of pairs of such images as a function of frequency separation of the bandwidths used and measuring the rate at which this curve falls off (2) determining the shape of the envelope of the radar signal transform The work in FY-81 is directed to evaluate unambiguously the ability of the SAR to provide wave height measurement and the physical limits over which this measurement is valid Existing data and Jet Propulsion Laboratory (JPL) processing capabilities will be utilized to provide this evaluation This will allow utilization of the SAR to provide wave height measurement in future SAR applications programs

W81-70335 **146-40-05**
Goddard Space Flight Center Greenbelt Md
REMOTE SENSING OF AIR-SEA INTERACTIONS PHENOMENA
F C Jackson 301-344-5380
(141-40-13)

This RTOP has the broad objective of improving remote ocean sensing capability by microwave techniques The following specific objectives refer to the three elements this RTOP comprises (1) to demonstrate a microwave radar technique for measuring ocean wave directional spectra from satellites (2) to refine the SMMR (scanning multichannel microwave radiometer) ocean algorithm and (3) to demonstrate the application of SMMR data to large scale air sea interaction problems Goddard short pulse radar data from the Fall '78 mission are analyzed to provide an experimental demonstration of proposed short pulse and two frequency nonimaging radar techniques In-situ data from ships and buoys are used to refine and verify SMMR algorithms for sea surface temperature (SST) and wind speed Selected SMMR data are analyzed for evidence of certain large scale air sea interactions (e g , storm forcing)

W81-70336 **146-40-06**
Langley Research Center Hampton, Va
MICROWAVE REMOTE SENSING FOR ICE PROCESSES RESEARCH
C T Swift 804-826-3631

The prime objective of this work is to provide a physically unambiguous basis for the interpretation and quantitative utilization of combined active and passive microwave remote sensing of sea ice characteristics and to report the results in the refereed literature The research will focus on the analysis of microwave data in hand both from the NASA C-130 flights conducted during the winters of 1978 and 1979 and polar data collected from the SeaSat A Satellite scatterometer (SASS) The process of analyzing the Beaufort Bering and Norwegian Sea data will require interfacing with Lewis Goddard, and Jet Propulsion Laboratory in order to enhance the Lantley data set As the analysis develops new questions will invariably occur which can only be answered by conducting new flight programs The planning will proceed as warranted and will require close coordination between the NASA Centers and the ice Scientists A second objective includes an evaluation task to define scatterometer performance characteristics for potential use as a satellite remote sensing instrument for ice processes The purpose is to establish the scientific and technical necessity for providing O deg vs incidence angle through the research mode antenna proposed System analyses will be continued to determine the data processing and engineering impacts of this research mode on the NOSS satellite A joint plan will also be formulated with appropriate scientists for the analysis of data collected in the research mode

W81-70337 **146-40-07**
Goddard Space Flight Center Greenbelt, Md
OCEAN CIRCULATION AND TOPOGRAPHY
J G Marsh 301-344-5324

The objectives of this research are to (1) provide physically unambiguous basis for the interpretation and quantitative utilization of remote sensing observations of sea surface topography (2) develop analytical and interpretative techniques for ocean circulation phenomena to satellite radar altimeter measurement of sea surface geometry and (3) formulate techniques for achieving orbital and ocean topography accuracies of 20 cm and 5-10 cm respectively Satellite altimeter data will be analyzed to develop maps of the global oceans Departures of this topographic surface from the geoid, or from the long term mean will be analyzed to yield information on dynamic ocean processes Collinear Seasat and also GEOS-3 profiles will be examined to study temporal and mesoscale variability of ocean currents The RTOP supports the following major programs (1) Seasat (2) NOSS (3) TOPEX These in turn support the following end objective of improving our knowledge and understanding of the general circulation

W81-70338 **146-40-12**
Jet Propulsion Laboratory Pasadena, Calif
SCATTEROMETER DATA ANALYSIS
Dudley B Chelton 213-354-5079

The objectives of this research are to help evaluate the usefulness of the altimeter and scatterometer for measuring sea surface topography and surface vector wind stress over the ocean and to use these measurements to statistically examine the dynamics of wind driven ocean circulation The approach taken will be to compare the satellite measurements with available surface truth data in selected geographical locations to determine the quality of the satellite data Based on the results of this stage of the analysis the work can then be extended to

study ocean-atmosphere interaction in regions where there is no available surface truth data

W81-70339 **146-40-13**
Wallops Flight Center Wallops Island Va
ADVANCED OCEAN SENSOR SYSTEMS DEVELOPMENT
J T McGoogan 804-824-3411
(146-40-05)

The objectives of this research are to provide a physically unambiguous basis for the interpretation and quantitative utilization of remote active microwave observations of oceanic conditions to assess the impact of same on relevant problems in oceanography, and to publish the results in the refereed literature to further develop satellite altimetry techniques towards supporting future missions such as TOPEX ICEX and related follow-on missions and to develop an overall plan that will identify the key technology that must be advanced and studies that are needed to investigate the potential of new techniques and system improvements More accuracy easier calibration longer life more rapid coverage new products (i e directional wave spectra direct current motion measurements etc) and more reliable performance over ice and land will be emphasized Requirements obtained from future mission plans will be used to establish those sensor changes that are most promising for future implementation New concepts will be analyzed and modeled, new hardware developed and tested and supporting studies conducted as required to firmly establish new sensor capabilities An overall error budget will be used to help establish priorities for system improvements

W81-70340 **146-40-13**
Langley Research Center Hampton Va
ADVANCED OCEAN SENSOR SYSTEMS DEVELOPMENT
C T Swift 804-827-3631
(146-40-05)

The objective of this work is to provide a physically unambiguous and accurate basis for the interpretation and quantative utilization of remote passive microwave sensors in studies of physical biological and geological oceanic processes The prime geophysical parameters of interest are salinity and temperature in both the coastal zones and open ocean and wind speed over the open ocean The approach is to install Langley precision radiometer systems on board NASA and NOAA aircraft to collect data in collaboration with scientists affiliated with other Government agencies and reputable oceanographic institutions Concurrent with this activity advanced passive sensors will be developed to expand the capability of existing passive microwave remote sensors For example, the UHF radiometer system currently under development will provide much more accurate measurements of ocean salinity as the water temperature becomes cold The work will also include the development of retrieval algorithms, analysis of data and reporting of results in the refereed literature

W81-70341 **146-40-15**
Langley Research Center Hampton, Va
COASTAL AND ESTUARINE DYNAMIC PROCESSES RESEARCH
Janet W Campbell 804-827-2871

The objective of this research is to provide a scientific basis for the interpretation and utilization of remote sensing in studies of estuarine and coastal marine environments Emphasis will be on developing the unique capability of remote sensors to provide synoptic mesoscale measurements to study dynamic biological physical and geochemical processes and their interrelationships Two major projects are (a) a continuation of the study of optical properties of turbid waters and (b) a new oceanographic remote-sensing experiment to study the coupling between the photoplankton patch formation and the movement of water on Nantucket Shoals Two new projects that are smaller in scope are (1) an intercomparison of existing techniques for converting a multispectral remote measurement to a true measure of water color and (2) a design study to consider the feasibility of integrating passive and active remote sensors into systems for meeting the needs of process-oriented marine science

W81-70342 **146-40-15**
Goddard Space Flight Center Greenbelt Md
COASTAL AND ESTUARINE DYNAMIC PROCESSES RESEARCH
Hongsuk H Kim 301-344-6465
(666-32-21)

Important objectives of this RTOP are to develop a capability to observe ocean phenomena including ocean bio-productivity ocean fronts and circulation features via aircraft or spaceborne ocean color scanners Activities in FY-81 will focus on further application of colorimetry measurements to meso- and large-scale ocean phenomena by participating in field experiments such as, GABEX and STS-2/OCE Chlorophyll distribution patterns in the ocean are an indicator of ocean bio-productivity and changes in water types which reflects the circulation and anomalies associated with main flow such as regional upwelling phenomena and meandering eddies

W81-70343 **146-40-18**
Lewis Research Center Cleveland Ohio
GREAT LAKES WATER QUALITY RESEARCH
James W Bagwell 216-433-6196

The objectives of this RTOP are to validate CZCS data and data products relative to user needs to develop accurate radiative transfer models for the atmosphere and the water and to report the results of the CZCS validation experiment and make recommendations pertaining to the development of new sensors The approach will be to identify the Great Lakes user community and determine their requirements A large data base that is suitable for use with the radiative transfer models and for use in CZCS algorithm development will be developed Products will be submitted to the use community for evaluation

W81-70344 **146-50-02**
Goddard Space Flight Center Greenbelt Md
SEVERE STORMS AND LOCAL WEATHER RESEARCH
J Simpson 301-344-5948
(146-50-02)

The objectives are to (1) relate improved remotely sensed properties of cloud systems and their environment to the diagnosis development and prediction of severe local storms and tropical hurricanes (2) adapt satellite data for numerical model initialization improvement assess VAS impact and (3) interact with user programs e g PROFS, CSIS future satellite design teams Methods to remotely measure from on-top crucial cloud and storm environment structure will be advanced and verified With improved data assimilation display systems combined data sets (satellite, radar, aircraft, surface conventional) from cooperative field programs namely SESAME 79, VAS Demonstration WB-57F with Hurricane Strike CCOPE 81 will be constructed Other approaches include performing case studies developing relationships between on-top incloud cloud interaction processes and methods to diagnose nowcast severe weather events as well as using models to relate data components and to perform numerical experiments on storm processes

W81-70345 **146-50-02**
Marshall Space Flight Center Huntsville Ala
SEVERE STORMS AND LOCAL WEATHER RESEARCH
William W Vaughan 205-453-3100
(146-30-02)

To contribute to the NASA Severe Storms and Local Weather Research Program by conducting applied research and development using space related techniques and observations that will increase the basic understanding of storms and local weather to improve the accuracy and timeliness of local weather forecasts and severe weather warnings The talents of university and private contractor groups plus the MSFC in-house talents and laboratory capabilities will be used

W81-70346 **146-60-01**
Goddard Space Flight Center Greenbelt, Md
OZONE DATA REDUCTION AND ANALYSIS AND SOLAR UV VARABILITY
Donald F Heath 301-344-6421
(147-10-01 147-30-01)

The objectives are to (1) develop stratospheric ozone climatology from satellite observations and investigations of processes and spatial and temporal from natural variability of stratospheric ozone (2) adapt LIDAR system for OH/O3 measurements from aircraft (3) provide ozone profile data in support of satellite measurements (4) investigate forms of solar activity and its effect on middle atmosphere and (5) solar flux and electrodynamic coupling Measurements of ozone UV solar flux and solar activity are analyzed in a variety of ways ranging from providing validation from rockets for satellites and harmonic and ozone trend analyses to producing inputs for verification by GCM's for the investigation of ozone and solar flux changes on the dynamics of the atmosphere Existing instrumentation is adapted for OH/O3 measurements from aircraft The RTOP studies of the uppoer atmosphere environmental quality and climate These in turn support the end objectives of determining the natural variability of the stratosphere and its role as well as that of the sun a parameter which might produce changes in climate

W81-70347 **146-60-01**
Langley Research Center, Hampton Va
STRATOSPHERIC MEASUREMENT PROGRAM ACTIVITIES
James M Russell III 804-827-2576
(147-40-01 147-30-01)

The overall objective is to develop evaluate and apply remote sensing technology to environmental monitoring of the stratosphere with the long range goal of providing this technology to those agencies charged with monitoring the stratosphere Specifically, work will focus on developing and evaluating remote sensor technology for stratospheric measurements on developing data interpretation techniques for satellite sensors on developing techniques for correlating ground aircraft rocket balloon and satellite data and on using available analytical models to expand existing and future data sets and provide the rationale for future measurement sets The approach will be to study and develop advanced concepts for long duration observation of stratospheric species to define key species in major chemical chains and use these results to study measurement requirements and to support the advanced concepts to develop and apply techniques needed to form a data base from all relevant sources and to compare existing data from ground aircraft balloon rocket and satellite measurements to use the data base to form reference models which can be compared to transport and radiation to gain improved understanding of physical processes and to design remote sensing strategies

W81-70348 **146-60-01**
Wallops Flight Center Wallops Island Va
IMPROVED MEASUREMENT AND CALIBRATION TECHNIQUES FOR STRATOSPHERIC TRACE SPECIES
T W Perry 804-824-3411

This RTOP aims to improve the quality of data from a variety of rocket-borne, balloon-borne and ground-based measurement systems used in support of the Upper Atmospheric Research Program and to identify future correlative support requirements and develop mission plans to meet these requirements The approach includes (1) laboratory studies to evaluate and improve accuracy and precision of ECC ozonesonde data under simulated stratospheric conditions (2) investigations into the incorporation of temperature sensors into rocket optical ozonesondes and into providing ranging capabilities for ECC balloon ozonesondes rocket meteorological datasondes and rocket ozonesondes (3) completion of the International Rocket Ozonesonde Intercomparison Project aimed at establishing instrumental precision and accuracy and at developing a common data base among the participating nations (4) determination of accuracy and precision and improvements in calibration techniques for rocket-borne chemiluminescent ozonesondes (5) intercomparison of five different ground-based total ozone spectrophotometers (6) devellopment of a portable total ozone spectrophotometer for field use and (7) development of mission plans to meet future correlative support requirements

W81-70349 **146-60-02**
Langley Research Center, Hampton Va
ENVIRONMENTAL MONITORING RESEARCH SATELLITE MISSION STUDIES
Edwin F Harrison 804-827-2977
(146-60-01 147-40-01)

The objectives of this RTOP are to perform mission analyses flight simulations and experiment definition studies for advanced flight programs aimed at remote measurements of atmospheric constituents Orbital analysis along with data sampling simulations will be conducted to determine the spatial and temporal coverage capabilities of various satellite experiments in meeting the measurement requirements established by scientific and user groups In particular trade-off analyses between Shuttle launch time orbit inclination and altitude will be made to maximize the geographical coverage of atmospheric Spacelab experiments such as Space Lidar Statistical sampling analyses will be conducted to define measurement opportunities for various Space Lidar experiments when taking into account cloud cover variability A parametric study will be performed to optimize scan modes and operation duty cycles for the experiments selected for the Upper Atmospheric Research Satellite The approach is to use existing in-house analytical techniques to address the orbital mission analysis and sampling studies These analyses will be conducted in collaboration with scientific working groups for satellite mission definition The computer simulations will be carried out by a combination of in-house and contractual efforts

W81-70350 **146-60-03**
Langley Research Center Hampton Va
ATMOSPHERIC LIDAR SYSTEM DEFINITION
J E Harris 804-827-3951

Atmospheric Lidar Multi-User Instrument System Definition activity will be continued with emphasis on system development risk reduction through prototype laser source development evaluation This RTOP will also continue experiment analysis using realistic shuttle lidar system parameters and atmospheric conditions The central objective of this research effort is to design fabricate and test a modular laser source which will have most of the optical parameters that would be necessary for inclusion in an atmospheric lidar instrument capable of being flown on a spacelab experiment This will be a phased effort in cooperation with specialized industry expertise The phases will include (1) the construction and testing of a 2 joule TME sub 00 Nd Yag laser source utilizing where possible existing military qualified components especially those components which have been developed to a high degree of reliability and performance (2) the building and testing of a frequency doubling module that could frequency double the 2 joule 10 Hz laser output (3) the design and development of a dye laser module which would be added to the basic laser module and frequency doubler module (4) the testing of the dye module to assure reliable means of frequency tuning and the investigation of several methods of maintaining operation at the desired wavelength and (5) an aircraft and flight testing of the combined three module subsystem integrated with an existing lidar and data acquisition system

W81-70351 **146-90-03**
Goddard Space Flight Center Greenbelt, Md
COST ANALYSIS OF SPACE FLIGHT SYSTEMS WITHIN THE OFFICE FOR SPACE AND TERRESTRIAL APPLICATIONS
Paul Villone 301-344-7179

The objective of this RTOP is to provide supported and detailed mission cost and manpower estimates for Goddard Space Flight Center (GSFC) candidate missions within the Office for Space and Terrestrial Applications A combination of in-house and out-of-house effort by the Resources Analysis Group (RAG) is required to support the above objectives The following task areas are included (1) data collection (2) data analysis (3) data integration (4) development of cost estimation techniques (5) updating of cost estimating relationshp (CERs) and (6) generation of cost estimates

Upper Atmospheric Research

W81-70352 **147-10-01**
Goddard Space Flight Center Greenbelt Md
UPPER ATMOSPHERE RESEARCH - FIELD MEASUREMENTS
R D Hudson 301-344-6358

The objectives of this research are (1) Determine the specific local chemical and physical interactions in the atmosphere by a combination of theoretical studies and coordinated in situ measurement campaigns from balloon rocket and aircraft platforms (2) Investigate the variations and perturbations of the chemical and physical state of the atmosphere, i e variations with altitude solar conditions season latitude and perturbations from volcanoes tropical storms industrial and agricultural activity (3) Develop and calibrate selected instruments for local and remote investigations of the atmosphere The approach to the research effort is (1) To develop a balloon borne lidar system a Michelson interferometer spectrometer, sub-millimeter radiometers, and a photoionization mass spectrometer to measure the concentrations and diurnal variations of trace stratospheric species (2) To perform laboratory studies of the resonance fluorescence of stratospheric species by single and two photon excitation in support of the lidar experiments (3) To measure ozone and the direct and diffuse components of the solar flux in the stratosphere and mesosphere and (4) To perform multi-instrument coordinated measurements of minor species in the stratosphere and mesosphere

W81-70353 **147-10-01**
Lyndon B Johnson Space Center Houston, Tex
IN-SITU MEASUREMENTS OF STRATOSPHERIC OZONE AND TOTAL CHLORINE
D E Robbins 713-483-5039

The objectives of this RTOP are to (1) measure total chlorine mixing ratios in the stratosphere with enough accuracy and precision to extend the knowledge of stratospheric photochemistry (2) measure strat- ospheric ozone concentrations in situ simultaneously with other species linked photochemically with ozone to support correlative studies and (3) measure ozone profiles up to 48km simultaneously with French group and intercompare results Whole air stratospheric samples will be collected cryogenically from a balloon platform and returned to ground where the chlorine content will be determined using neutron activation analysis An existing ozone instrument which uses ultraviolet photometry will be flown piggy back on balloon platforms of investigators measuring other species involved in ozone photochemistry After completing certain modifications in the existing ozone instrument s design, it will be flown on dedicated balloon platforms along with a French instrument which employs chemiluminescence to measure ozone The two instruments have comparable accuracies and temporal resolutions The improved NASA-JSC instrument will be capable of observing ozone densities as low as 10 to the 11th power molecules/cm3 with an accuracy of 2% and a precision of 0 5% Both instruments are capable of making measurements higher than 48 km

W81-70354 **147-10-02**
Jet Propulsion Laboratory Pasadena Calif
STRATOSPHERIC RESEARCH, FIELD MEASUREMENTS PROGRAM
W T Huntress 213-354-2140

The overall objective of the JPL Upper Atmospheric Measurements Program is to obtain measurements needed for understanding the basic physics chemistry and transport of the upper atmosphere Highest priority is given to those measurements necessary for assessing the extent to which man s technological activities may affect the upper atmosphere At present five techniques are included in the program (1) infrared interferometry (2) infrared heterodyne radiometry (3) millimeter and submillimeter radiometry (4) pressure modulation infrared radiometry (in collaboration with Oxford University) and (5) laser absorption spectroscopy The first four of these are remote sensing techniques with instruments having already been developed for balloon or aircraft The fifth technique measures absorption between a balloon gondola and lowered reflector an instrument is now being developed A major FY-81 goal of the JPL program is to fly the four remote sensing instruments mentioned Above together on a multi-sensor balloon gondola (already constructed) to simultaneously obtain many measurements needed for understanding stratospheric chemistry, particularly the chlorine cycle of ozone destruction HCl ClO ClONO2 CH3Cl CFCl3 CF2Cl2 HC H2O H2O2 O3 CH4 NO2 NO N2O HNO3 and possibly HO2 HOCl HO2NO2 N2O5 and COS Longer term goals of the program include continued multi-sensor balloon measurements as needed and certain measurements (e g ClO) with individual sensors

W81-70355 **147-10-02**
Langley Research Center Hampton Va
EVALUATION OF ADVANCED SENSOR CONCEPTS FOR SATELLITE MONITORING OF THE STRATOSPHERE
M P McCormick 804-827-2466

The objective of this RTOP is to develop satellite sensor concepts for the measurement of upper atmospheric trace gases and aerosols by performing balloonborne spectrometer measurements of UV-visible solar earth-limb extinction At Langley this area of research is being supported by three RTR s Under this 147-10-02 program balloonborne spectrometer measurements are made in the solar extinction geometry These data are analyzed under the 146-60-01 program providing spectrometer specifications and feasibility for the conceptual design of advanced satellite sensors throughput source and constituent strength analysis and channel selection via the measured spectra for SAM II SAGE and SAGE II programs and spectrometer characteristics for future balloon flights and improved measurement techniques The objective of this program is to also provide stratospheric profiles of trace gases such an NO2 OH ClO etc The conceptual satellite sensor hardware design studies utilizing these data and analyses are supported by the 146-60-02 program with primary funding under contract to Ball Aerospace

W81-70356 **147-10-03**
Ames Research Center Moffett Field Calif
ATMOSPHERIC PROCESSES, EXPERIMENTS AND SYSTEMS
W A Page 415-965-5404
(146-10-04 146-20-23)

The objective of this research is to obtain observational data regarding the vertical transport into the stratosphere of tropospheric species (such as CFMs N2O sulfur compounds and water vapor) and the latitudinal and downward transport of stratospheric species (such as NOX O3 HNO3 and aerosols) and to develop and integrate new airborne instrumentation to measure key trace gas species on board aircraft aircraft and balloon platforms The ability to make coordinated simultaneous measurements is being emphasized Of interest currently is the important vertical transport that is thought to occur in tropical meteorological events such as active ITCZ periods midlatitude jets and in antarctic regions The approach is to form experiment working groups composed of theoreticians and experimenters to design the appropriate observational missions to participate in making and analyzing measurements and to evaluate the results of the missions Inasmuch as the regions of interest are the upper troposphere and the lower stratosphere aircraft are excellent platforms Typical experimenters use a medium-altitude aircraft such as the CV990 or Lear Jet and a high-altitude aircraft the U-2 each of the aircraft carries several instruments in order to measure all the species of interest Ancillary meteorological data are collected by special balloon soundings from neighboring weather stations and from meteorological satellite coverage

W81-70357 **147-20-01**
Goddard Space Flight Center Greenbelt Md
UPPER ATMOSPHERE RESEARCH - LABORATORY MEASUREMENTS
R D Hudson 301-344-6358

The objective of this research is to measure chemical kinetic rate coefficients of importance to the stratosphere and mesophere The laboratory effort in chemical kinetics uses existing equipment of unique capability for the purpose of measuring absolute rate constants of reactions of importance in current models of the stratosphere Rate constants are measured as a function of

temperature and pressure and under conditions in which the number of atoms is much less than the number of molecules

W81-70358 **147-20-01**
Jet Propulsion Laboratory Pasadena Calif
CHEMICAL KINETICS
W B DeMore 213-354-2436

A program of laboratory studies will be conducted in the following areas (1) chemical kinetics of the upper atmosphere (2) photochemistry of the upper atmosphere (3) data survey and evaluation and (4) ionic processes in the upper atmosphere The program will be designed to provide data needs and guidance for both chemical models and field measurements Primary emphasis will be on the acquisition of kinetic data including reaction rate constants temperature dependences and product formation Photochemical quantum yields, absorption cross sections and product distributions will be measured A broad base of data knowledge in all the foregoing areas will be maintained through literature surveys and through contract with other groups active in these areas Laboratory studies will be conducted on ionic processes in the upper atmosphere in particular ion-molecule reactions important in the natural and perturbed mesosphere

W81-70359 **147-20-03**
Ames Research Center Moffett Field Calif
QUANTITATIVE INFRARED SPECTROSCOPY OF MINOR CONSTITUENTS OF THE EARTH'S STRATOSPHERE
R W Boese 415-965-5501

Remote detection and measurement of stratospheric species via spectroscopic techniques is being routinely employed to develop a better understanding of this portion of our atmosphere and mans effect upon it Proper interpretation of these measurements relies strongly on having the correct laboratory data The objective of this work is to obtain laboratory measurements of basic molecular parameters, such as rotational line intensities and half-widths absorption band intensities vibrational and rotational constants vibration-rotation interaction constants line position measurements including pressure induced shifts and Franck-Condon factors The determination of these paremeters, and their dependence on pressure and temperature will be obtained by using long path gas cells cooled and heated cells and high resolution interferometers and spectrometers

W81-70360 **147-30-01**
Goddard Space Flight Center Greenbelt Md
UPPER ATMOSPHERE RESEARCH - THEORETICAL STUDIES
R D Hudson 301-344-6358

The objectives of this research are (1) Provide the framework for developing and understanding an organized solid body of knowledge of the physics chemistry and dynamics of the Earth's upper atmosphere (2) Analyze data from upper atmospheric flight programs and (3) Predict and assess the effects of natural and man-related perturbation on the atmosphere Approaches include (1) Develop a simplified one dimensional model for sensitivity and error propagation analyses (2) Develop a diurnal detailed chemistry, one dimensional models for studies of stratospheric photochemistry (3) Develop a global general circulation model (4) To study the NIMBUS 4 and NIMBUS 7 ozone data to elucidate dynamical effects and global trends (5) To use data from instruments on the Solar Maximum Mission to study mesospheric chemistry (6) To evaluate current knowledge of the upper atmosphere

W81-70361 **147-30-01**
Langley Research Center Hampton, Va
STRATOSPHERIC THEORETICAL STUDIES AND SCIENCE DEFINITION ACTIVITIES
R H Tolson 804-827-2530

The objective of this RTOP is to conduct theoretical studies of stratospheric phenomena in conjunction with the analysis of stratospheric data and computational chemistry studies of reactive stratospheric molecules Using contemporary satellite data, theoretical studies will be performed in the general areas of photochemistry trace constituent budgets and the effects of a sudden stratospheric warming Balloon measurements of NO and NO2 will be inverted interpreted for diurnal variations and compared to time-dependent model calculations These results will be related to LHS experiment definition studies Computational chemistry studies will focus on determining the ground state structures excited states and heat of formation of NO3

W81-70362 **147-30-01**
Jet Propulsion Laboratory Pasadena Calif
PHOTOCHEMICAL MODELING OF TRACE SPECIES IN THE STRATOSPHERE AND MESOSPHERE
R T Watson 213-354-2231

This work will be performed via an R&D contract to Professor Y L Yung California Institute of Technology (Caltech Contract 064207) He will use the one-dimensional diurnal photochemical model to investigate the distribution of minor species in the stratosphere and mesosphere in support of the JPL joint balloon experiments An understanding of the partitioning between the ClO family ClO HCl, HOCl and ClONO2 and the NOx family, NO NO2 HNO3 and HO2NO2, and measurement strategy will be one of the primary objectives In addition photochemistry and transport of O O3 and CO in the mesosphere will also be modeled

W81-70363 **147-30-02**
Ames Research Center Moffett Field Calif
STRATOSPHERIC RESEARCH
E F Danielsen 415-965-5527
(147-20-03 346-10-04)

The objectives of this research are to increase our understanding of the dynamics, thermodynamics and chemical composition of Earth s stratosphere and mesosphere to assess the effects of natural and man-caused perturbations on their structure and composition (e g the radiative balance and the ozone abundance) and to collaborate with the academic community to advance atmospheric model development Several types of chemical-dynamical and dynamical models of the stratosphere and mesosphere have been or are being developed to study the complex interactions of radiative photochemical chemical, and transport processes including the effects of vertically propagating internal waves and stratospheric-tropospheric exchange Also diagnostic analyses of the three dimensional velocities and thermal structure of the upper troposphere and stratosphere will be made to provide standards for comparison with the models simulations Research includes a three dimensional model being developed at Ames development of a low, wave number semi-spectral model of the middle atmosphere at the University of Washington diagnostic studies of the northern hemisphere at San Jose State and Ames analyses of stratospheric exchange in the tropics based on the NASA-Ames ITCZ experiments by scientists at Ames and the Center for Environment and Man and computational support of a detailed aeronomical model at Harvard Ab initio computations of molecular processes important to stratospheric photochemistry are also being carried out

W81-70364 **147-30-02**
Goddard Inst for Space Studies New York
STRATOSPHERIC MODELING
James Hansen 212-678-5593

Multidimensional atmospheric modeling is utilized to analyze coupling between stratosphere and global climate with emphasis on radiation effects Atmospheric modeling capability is developed for the stratosphere and troposphere as required to analyze interactions between the stratosphere and global climate Models are utilized to help assess potential climatic implications of stratospheric change and to help define measurement requirements associated with assessment of stratosphere/climate interactions

W81-70365 **147-40-01**
Goddard Space Flight Center Greenbelt Md
UPPER ATMOSPHERE RESEARCH SATELLITES (UARS) DEFINITION STUDY
P T Burr 301-344-8536

The UARS mission objective is to understand (1) the mechanisms that control the upper atmosphere structure and

variability (2) the response of the upper atmosphere to natural and anthropogenic perturbations and (3) the role of the upper atmosphere in climate To achieve these objectives the UARS will study (1) the energy input and loss in the upper atmosphere (2) the global upper atmospheric photochemistry (3) the dynamics of the upper atmosphere and (4) the coupling among processes and between atmospheric regions The objective of this RTOP is to perform the necessary studies that will explicitly define the two UARS spacecraft and their ground analysis requirements Documentation required for a FY-82 new start execution phase will be prepared including an Execution Phase Project Plan During CY-80 technical support will be provided to headquarters and study contracts will be issued to each chosen investigator in the June to July period Contracts for mission design studies will be issued in FY-81 The results of these studies will be used to produce the Execution Phase Project Plan By solving technological concerns early the studies will ensure an on-schedule and within cost project

W81-70366 **147-40-01**
Langley Research Center Hampton, Va
LASER HETERODYNE SPECTROMETER (LHS) BRASS-BOARD
Frank Allario 804-827-2576
(506-61-33)

The objective of this research is to develop a two gas simultaneous laser heterodyne spectrometer (LHS) experiment to measure tenuous gas molecules in the stratosphere from aircraft and balloon platforms using the solar occultation technique Target molecules for this investigation include ClO ClONO2 HOC2 HOCl HO2 H2O2 HNO2 HO2NO2 and N2O5 The LHS brassboard instrument will perform measurements from an aircraft (NASA CV-990) and a balloon platform (> 38 km) Aircraft flight tests will be conducted in CY-82 and a balloon flight program will be conducted in CY-83

Space Processing

W81-70367 **179-20-55**
Jet Propulsion Laboratory Pasadena Calif
ADVANCED CONTAINERLESS PROCESSING TECHNOLOGY
T G Wang
(179-70-10)

The primary long-range objectives of this task are to (1) study and advance the science of contactless positioning and manipulation of a high temperature acoustic chamber (2) provide design information on a flight version of this chamber for material science studies in a contactless and zero gravitation environment (3) provide potential MPS investigators with a set of ground-based facilities with which to perform precursor experiments Presently JPL is under contract to develop a high temperature ACES for early OSTA shuttle flights However many important facets of high temperature containerless processing technology have not yet been established, and some of the more sophisticated processing technology required for future shuttle flights is not available today Detailed experimental and theoretical studies of containerless processing technology to be performed in this task will enable us to meet stringent requirements in the future The objectives to be addressed in FY-81 are experimental and theoretical studies of (1) acoustic positioning and manipulation capabilities of a rectangular chamber as a function of temperature and pressure (2) various acoustical geometries which may have special application in materials science studies, (3) loss mechanisms associated with high intensity and high temperature acoustic waves (4) aero-acoustic positioning system which will allow us to levitate heavy samples in the laboratory (5) liquid-liquid positioning system which will allow us to study the dynamics of liquid melts and (6) positioning and manipulation capability of a KC-135 acoustic module In addition a new effort will be initiated this year to provide potential MPS investigators a set of facilities will allow investigators to examine and compare the properties of their samples processed in the following four ways one-g contained one-g containerless zero-g contained and short duration zero-g containerless

W81-70368 **179-20-56**
Jet Propulsion Laboratory Pasadena Calif
ELECTROSTATIC CONTROL AND MANIPULATION OF MATERIALS FOR CONTAINERLESS PROCESSING
M M Saffren 213-354-2352

The objective is to demonstrate techniques and develop technology for electric field positioning and manipulation of materials for containerless processing investigator applications Electric field containerless processing apparatus satisfying requirements of potential investigators will be demonstrated no later than CY-83 This will lead to the design of flight facilities and also laboratory theoretical and numerical study KC-135 and Shuttle flights will be utilized The objectives and approach of the two task elements are development of requirements of potential investigators-and Electric Field Positioning Science Working Group to be formed will guide technology by imposing well-defined specific requirements This Group will play the major role in defining facility requirements An individual investigator would be funded through response to NASA AN s and the funding administered under this RTOP Behavior of liquid drops in electric fields is to be applied to electric field positioning cloud physics fusion target technology and illustration of physical principles The work deferred from FY-80 will be completed in FY-81 In addition an acoustic/electric field positioning apparatus to help study electric field positioning of bulk objects will be designed and tested Conceptual design of a speceflight test of electric field positioning will begin The modes of compound drops which produce centering will undergo quantitative study The interaction of the melting/freezing process and electric field positioning will be studied A film/video-tape utilizing electric control of drops will be prepared for the NASA Film Library The Science Working Group will be constituted there will be two meetings this year

W81-70369 **179-20-57**
Jet Propulsion Laboratory Pasadena Calif
FUSION TARGET TECHNOLOGY STUDY
T G Wang 213-354-6331
(179-80-30)

The objectives of this RTOP are to (1) study the physical processes that are associated with the fabrication of inertial confinement fusion (ICF) targets in a weightless environment (2) determine jointly with DOE centers the need for extended zero gravity in the future production of ICF targets (3) provide technical information to DOE centers that is pertinent to their current target fabrication research In order to produce the high quality fusion target shells that are required four fundamental physical processes must be understood spheroidization of the shell uniformity of shell thickness and coating adiabatic expansion and contraction of the molten pellet and solidification of the molten pellet as it passes through temperature and temperature gradient environments The present pellet manufacturing techniques are not set up to study these processes separately Attempts to conduct experiments on the dynamics of liquid bubbles (molten pellets) in laboratories are limited by insufficient pellet size for accurate observation limited time for experimentation and a strong coupling between the two parameters, time and temperature which precludes identification of the fundamental processes The work described here will circumvent these limitations and enable detailed study of each of the important processes through use of low gravity environments collectively available within the KC-135 aircraft facility in drop towers in a neutrally buoyant immistible system and in an acoustic levitation system The primary activities of this task in the next year are to (1) study the fluid dynamics processes that pertain to pellet fabrication processes such as bubble centering coating uniformity and various instabilities (2) study the effects of various temperature levels and temperature gradients on pellet fabrication (3) construct Earth-based high-temperature and high-temperature gradient drop towers (4) initiate development of a process for the fabrication of metal and metallic glass shells, (5) conduct theoretical studies and numerical analyses on various pellet fabrication processes

W81-70370 **179-70-10**
Jet Propulsion Laboratory Pasadena Calif
ACOUSTIC CONTAINERLESS EXPERIMENT SYSTEM (ACES)
D Kerrisk 213-354-2566
(179-20-55 179-80-30 179-20-57)

The objectives of this RTOP are (1) to develop and demonstrate a breadboard for a first flight Acoustic Containerless Experiment System (ACES) capable of performing useful science and achievable with current technology and (2) to undertake the technology development effort needed to expend the science capability of future ACES JPL is working with the ACES Science Working Group (SWG) during FY-80 to define the capabilities that should be incorporated in a first flight ACES and to establish science priorities for expansion of those capabilities for later ACES flights On the basis of the SWG recommendations JPL will produce by the end of FY-80 a program plan for FY-81 and FY-82 which includes the conceptual definition of a breadboard ACES to be built during FY-81 and FY-82 which would allow the development of a flight ACES to begin in FY-83 with high technical confidence and low cost risk The programming plan will also identify the technology development activities needed to expand the capability of later ACES in accordance with science priorities During FY-81 the detail design of the breadboard ACES and the facility for its test and evaluation will be undertaken and procurement/fabrication of the breadboard subsystems, and preparation of the test facility will be initiated This activity will continue into FY-82 Concurrently the technology development effort defined in the program plan will be set in motion

W81-70371 **179-80-10**
Langley Research Center Hampton Va
INFRARED DETECTOR MATERIALS RESEARCH
R K Crouch 804-827-3661
(542-03-30)

The objective is to develop techniques to grow bulk semiconductor single crystals that are required for future infrared detection and electronic device development Analytical studies and laboratory investigations will be conducted to define better the causes of crystalline defects such as voids, dislocations grain boundaries and inhomogeneities in these materials Special emphasis will be placed on crystal growth in space

W81-70372 **179-80-10**
Jet Propulsion Laboratory, Pasadena Calif
INFRARED DETECTOR MATERIALS PREPARATION
John A Zoutendyk 213-354-3214
(179-02-62 179-03-62)

The research program is aimed at the exploitation of the low-gravity space environment for the growth of single-crystal materials for infrared (IR) detectors having characteristics unattainable in an earth-gravity growth configuration The long-term objective is to determine the effect(s) of gravity-driven convection in crystal growth of the IR semiconductors PbSnTe and CdTe (the latter is a substrate material for HgCdTe epitaxial crystal growth) The objectives for FY-81 are to perform ground-based crystal growth experiments and characterization of the resulting materials Vapor-phase growth of PbSnTe will be done at JPL and liquid-zone growth of CdTe will be done under contract at Rockwell Science Center

W81-70373 **179-80-30**
Jet Propulsion Laboratory Pasadena Calif
GLASS RESEARCH
G Nelson 213-354-6365

This RTOP relates to the Materials Processing in Space effort It consists of two distinct, but related efforts (labeled A, and B) aimed at dealing with fundamental and practical questions pertaining to the processing of glasses in space Studies A and B focus on the use of MOD (metal organic derived) or gel materials for glass preparation in space Effort A is an investigation aimed at elucidating the properties and behavior of MOD glasses specifically the phase separation and crystallization behavior This program will be performed at JPL B is an applied research effort aimed at producing ultrapure optical fibers from such gel glasses and is being pursued at Battelle Memorial Institute Programs A and B were initiated via responses to an AN, and currently consist solely of ground based research work

W81-70374 **179-80-80**
Jet Propulsion Laboratory Pasadena Calif
BIOSEPARATION
Alan Rembaum 213-354-3189

The long term objective of this RTOP is to electrophoretically separate cell subpopulations in space which are very difficult or impossible to separate on the ground The study of the experimental conditions required to separate red blood cells (human and sheep) of high and relatively uniform electrophoretic mobility has been completed The absence of gravity and therefore thermal convection in space eliminates one important obstacle for optimum electrophoretic resolution of cells of nonuniform mobility Therefore the specific goals for FY-81 are (1) the study of the experimental conditions to determine the limit of ground based electrophoretic separation of cells of lower and less uniform electrophoretic mobility (2) the study of the viability of the separated cells and (3) design of a flight experiment to demonstrate improved electrophoretic separation of cells with a lower and less uniform mobility Various techniques are at present used to separate biological cells In many cases these techniques are relatively successful However some cell subpopulations morphologically identical but immunologically very different cannot be separated or isolated by any available means One of the most promising possibilities for a solution to this problem is the application of immunological principles used in cell labeling i e interaction of fluorescent antibodies with cell subpopulations This successful immunofluorescence technique is now widely used to identify different types of cells which have an identical shape and form even when examined in the most powerful electron microscopes Attempts to use electrophoretic methods to separate cells labeled with fluorescent antibodies were not successful because the electrophoretic mobility of labeled cells was not sufficiently different from that of unlabeled cells We have demonstrated in FY-80 that human (hrbc) as well as sheep red blood cells (srbc) can be easily separated in free flow electrophoresis instruments This separation was achieved by labeling the cells with microspheres carrying fluorescent antibodies on their surface i e immunomicrospheres The labeling altered the electrophoretic mobility of hrbc and srbc sufficiently for a successful electrophoretic separation on the ground

Technical Consultation and Support Studies

W81-70375 **643-10-01**
Jet Propulsion Laboratory Pasadena Calif
TECHNICAL CONSULTATION SERVICES
W J Weber 213-354-3845
(643-10-02)

The objective of this RTOP is to ensure the growth of space applications by providing the technical basis and regulatory framework needed to obtain sufficient spectrum/orbit to meet current and projected requirements The results of this work will be used by NASA to help determine its frequency and orbit requirements and to ensure compatibility between NASA flight programs and other space and terrestrial services The results will also be used by NASA and other government agencies for the purpose of supporting CCIR and World and Regional Administrative Radio Conferences in making decisions on frequency/orbit utilization and assignments ground-station and satellite approvals and in providing for the growth of existing and new satellite services The approach in general is to participate in studies for NASA CCIR and Administrative Radio Conferences These studies include frequency/orbit use justifications sharing criteria and implications technical system standards digital system modeling frequency reuse characteristics of multiple beam antennas spectrum conservation aspects of various modulation and coding techniques multiple access and on-board signal processing and switching for more efficient satellite utilization and intersatellite links Specific tasks and studies for FY-81 include

sound broadcasting via satellite broadcast satellite technology multiple beam antenna performance analysis transponder linearity/modulation tradeoffs digital TV modulation evaluation satellite capacity doubler adaptive antenna feasibility multi-beam antenna-concepts and technology institutional studies for the land mobile satellite service

W81-70376 **643-10-01**
Lewis Research Center Cleveland Ohio
TECHNICAL CONSULTATION SERVICES
E F Miller 216-433-4000

The objective of this RTOP is to provide technical consultation services support in the area of space services with particular emphasis on preparing for international meetings relating to the broadcast-satellite service (BSS) the fixed-satellite service (FSS) and the mobile-satellite service (MSS) provide the technical basis and regulatory framework needed to obtain sufficient orbit/spectrum to meet current and projected req uirements of NASA and the United States and to perform studies, conduct evaluations identify technology status and needs perform measurements (where necessary) and evaluate alternatives that result in efficient use of the geostationary orbit/spectrum resource In support of the 1983 WARC (World Administrative Ratio Conference) we will develop analytic methods and tasks for planning examine alternate planning approaches determine parameters and cost determine sharing criteria and perform critical technology developments applicable to the BSS In support of the 1984/1986 Space Services WARC we will develop and evaluate alternative regulatory approaches determine planning parameters including sharing criteria examine alternate planning approaches identify technological risks and costs and examine the spectrum efficiency advantages of digital television for the FSS In support of the 1982 Mobile Services WARC we will determine example MSS systems develop sharing criteria by analysis and measurements and develop a simulator of mobile communications channels We will also conduct the described activities within the framework and schedules of the applicable CCIR Study Groups the special preparatory committees established in the U S, and the international meeting called to support preparations for the Conferences Efforts described are a combination of in-house and contract activities

W81-70377 **643-10-02**
Jet Propulsion Laboratory Pasadena Calif
COMMUNICATION SATELLITE APPLICATION SYSTEMS
W J Weber 213-354-3845
(643-10-01 643-10-03)

The technical objectives of this RTOP include aid in providing for the growth of existing satellite services and new communications satellite applications and ensuring compatibility of NASA s communications flight programs with other space and terrestrial services This aid is particularly related to NTIA s charter to facilitate the transfer of space technology for public service applications Government procedures require all agencies to submit proposed new space systems concepts to IRAC and OMB for review four to six years prior to their their planned date of initial operation This is to ensure spectrum availability for telecommunications systems prior to commitment of public funds In order to fulfill this requirement this RTOP will include studies of systems concepts with potential applications within the NASA Communications Program These studies will include conceptual designs user functional requirements technical requirements system descriptions frequency and bandwidth requirements cost effectiveness system tradeoffs and sharing studies required to demonstrate compatibility with existing or planned services Studies for FY-81 will include the land mobile satellite service satellite communications systems concepts for the Pacific Ocean region, satellite communications for utility control monitoring and load management and other potential narrowband services for commercial and public service applications The studies will be consistent with an integrated narrowband program plan within the NASA Communications Program

W81-70378 **643-10-02**
Lewis Research Center Cleveland Ohio
COMMUNICATIONS SATELLITE APPLICATIONS SYSTEMS
J R Ramler 216-433-4000

The objectives of this effort are to (1) identify and characterize multi-service thin-route (MSTR) markets suitable for satellite service and determine the role of satellites for providing these services and (2) identify and define the technology developments and service demonstrations required to verify that cost-competitive spectrum-conservative MSTR operational satellite service could be delivered in the 1990 s The approach will be to conduct the following in-house and contracted studies (1) market/economic studies (2) system concept and competitive systems analyses and (3) institutional and regulatory assessment studies

W81-70379 **643-10-03**
Jet Propulsion Laboratory Pasadena Calif
SYSTEMS COORDINATION SUPPORT
William J Weber 213-354-3845
(643-10-01)

At the present time propagation uncertainties represent major constraints in Earth-space propagation in the mobile service and above 10 GHz This RTOP supports the improvement of our knowledge of the propagation mechanisms in Earth-space propagation the preparation of predictive models for such propagation the validation of these models through comparison with measurements and the preparation of reports and presentations of the results to allow the work to be evaluated by the scientific community The output of the work will be made available in forms which will be appropriate to the needs of those organizations involved in the effective utilization of the frequency spectrum for space applications (e g FCC IRAC CCIR WARCs) Improvement in the estimation of link performance will be the guiding concern in this work It is planned that this program will be carried out in concert with systems planning of flight projects thus insuring the relevance of the propagation studies Anticipated products include (1) CCIR reports to Study Group 5 (sky noise temperature including the effects of clouds and rain and extraterrestrial emissions) and Study Group 6 (extraterrestrial propagation Faraday rotation on Earth-space paths) (2) contributions to NASA propagation handbooks (3) presentations at meetings of URSI and IEEE Antennas and Propagation Society (4) journal articles and (5) computer programs

W81-70380 **643-10-04**
Jet Propulsion Laboratory Pasadena Calif
REMOTE SENSING FREQUENCY COORDINATION STUDIES
N F de Groot 213-354-3768
(643-10-01)

The objective of the RTOP is to ensure effective remote sensing projects through the best utilization of allocated radio frequency bands and to provide the basis for appropriate frequency assignment in those bands There is a need to coordinate radio frequency requirements for OSTA remote sensing project prior to requesting frequency assignments through established channels There are a number of reasons for this coordination (1) The World Administrative Radio Conference (WARC) has recently allocated a large number for frequencies for active microwave sensors passive microwave sensors and associated data read-out frequencies Whenever possible NASA satellites should operate in the allocated frequency bands where their operations will be protected from harmful interference as well as protected from the interruption which could occur if the satellites should operate in non-allocated bands and cause harmful interference (2) Alternatives can be examined and advice provided to OSTA managers engineers and scientists when problems having programmatic impact arise in frequency selections (3) Programmatic plans for development of operational systems can be factored into frequency selections to ease the transition from experimental to operational projects The approach of this RTOP will be to assist in the selection of bands to be used by remote sensing projects from the stand point of sharing the bands with other

radio services as well as from the standpoint of instrument requirements

W81-70381 **637-01-02**
Jet Propulsion Laboratory Pasadena Calif
SYSTEMS FOR UNDERWATER SURVEY AND EXPLORATION (SUSE)
W Gulizia 213-354-3651

The purpose of this RTOP is to continue to demonstrate the applicability of space program derived systems techniques and advanced technology to facilitate and expedite undersea exploration and operations Use will be made of the existing digital deep-towed instrument platform coupled with its shipboard data processing system to provide an in-situ test and demonstration capability to advance the technological needs and techniques of expressed value to the ocean community-and for which a unique capability exists at JPL These may include but are not limited to such technologies as solid state TV imaging improved sub-bottom profiling synthetic aperture sonar improved power systems laser scatterometer advanced data systems with near-real time mosaicking capability, and artificial intelligence It is a long range objective to this effort to evolve in the direction of an increasingly sophisticated underwater vehicle system--a self-contained maneuverable, free-swimming vehicle The approach will utilize JPL capabilities in the design of digital data processing systems and instrument platforms Design techniques and software developed through NASA/JPL sponsorship of the Unified Data Systems (UDS) Remote Terminal Unit (RTU), Artificial Intelligence (AI) Image Processing (IP) and Advanced Teleoperator Technology will be utilized wherever appropriate in the advanced deep-towed submersible system design A multi-disciplined design team has been formed of JPL personnel experienced in design of digital signal and data processing displays computer image processing power sonar instruments and electronic packaging The Marine Physical Laboratory of the Scripps Institution of Oceanography will participate in the development of the submersible system as consultants to provide assistance in the areas of sonar instrument design theory vehicle operations electrical performance of the tow cable and ocean surveying requirements

W81-70382 **637-01-03**
Langley Research Center Hampton Va
SYSTEMS FOR MARINE ENVIRONMENT PREDICTION (AIRBORNE ACTIVE/PASSIVE MICROWAVE)
W F Croswell 804-827-3631

The technical objective of this RTOP is to provide a technology transfer of the results of NASA remote sensing research to user oceanic agencies such as NOAA to fulfill their regional operational requirements for airborne measurements of selected ocean properties Typical applications could be the winds and significant wave height in the vicinity of pollution accidents such as oil spills and in other instances timely surface temperature and salinity distributions to aid in circulation studies etc For FY-80 the work focused on studies to define user measurement requirements establish national priority needs and begin the development of technology transfer plans which include operational implementation For FY-81 the results of user studies will be analyzed system and instrument design initiated and user involvement developed

W81-70383 **637-01-04**
Jet Propulsion Laboratory Pasadena Calif
SEAFLOOR AUTOMATED LANDER TECHNOLOGY (SALT) (FORMERLY THE HIGH ENERGY BENTHIC BOUNDARY LAYER EXPERIMENT--HEBBLE)
Kent Frewing 213-577-9309

This activity will broaden the FY-79 and FY-80 High Energy Benthic Boundary Layer Experiment (HEBBLE) task into a more general effort aimed at developing Seafloor Automated Lander Technology (SALT) The objectives of the activity are twofold (1) to apply NASA's institutional expertise in system design, engineering and system integration to problems in oceanography and to transfer aerospace technology to the oceanographic community and its sponsors and (2) to understand the physical and biological processes at selected dynamically active sites in the benthic boundary layer (and their interaction with the seabed) to determine their rates and predict their behavior In FY-79 and FY-80 emphasis was on program planning and preliminary design of the HEBBLE central lander In FY-81 emphasis will be on developing specific hardware items carrying out tests and designing equipment that is required for the system design of seafloor landers System engineering will be performed on an instrumented seafloor flume a precursor to a HEBBLE central lander The flume will be a cooperative effort with the Woods Hole Oceanographic Institution (WHOI) and co-sponsorship is being sought from the Office of Naval Research (ONR) Specific seafloor lander technology that will be studied as part of this RTOP will include (1) observation of how seafloor lander footpads affect the seafloor and BBL flow (2) design and fabrication of a conditional sampler, (3) a study of potential energy sources for a long term seafloor lander and (4) a study of the feasibility of using a satellite link to obtain data from a seafloor lander

Advanced Communications Research

W81-70384 **650-20-16**
Lewis Research Center Cleveland Ohio
30/20 GHZ WIDEBAND SYSTEM DEFINITION
J R Ramler 216-433-4000
(650-60-18)

30/20 GHz program operational studies are required to provide a continuing focus for NASA technology development and to help insure the relevancy of potential demonstration satellite systems The objective of the studies are (1) to assess and characterize the technical and economic requirements of potential operational satellite communications systems utilizing Ka-band and (2) to identify and define potentially viable concepts The approach incorporated in these studies involves an assessment of markets for satellite supplied communications services definition studies of advanced satellite systems to meet the predicted market demands and network design/cost modeling to determine optimum approaches to implementing these advanced systems into existing communications networks In some cases these efforts will update refine and extend previous Ka-band market and advanced systems studies

W81-70385 **650-60-18**
Lewis Research Center Cleveland Ohio
GHZ WIDEBAND COMMUNICATIONS SATELLITE PROJECT DEFINITION
R T Gedney 216-433-4000
(650-60-21 650-60-23 650-20-16 650-60-20 650-60-22)

The objective is to plan for the demonstration phase of the 30/20 GHz wideband communications satellite program The domonstration phase (phase III) will be for the procurement and experiment operation of a 30/20 GHz demonstration system including flight spacecraft and ground terminals for trunking customer promises and emergency communications services During the current phase (phase II) conducted in FY-80 and FY-81 preparations will be made for the new project start in FY-82 the mission level requirements will be defined for the demonstration system the experiment capability required by the demonstration system will be defined required memoranda of agreement for mission operations will be prepared and the phase III request for proposals will be prepared Coordination and interaction will be provided with representatives of the service carriers to determine the system functional requirements and experiment requirements Communication system supplier studies (phase II) will each provide demonstration system design data experiment plans system development plans technology development plans and a mission level requirements document The contractor generated requirements documents will be synthesized by NASA into a mission requirements document for the phase III request for proposal

W81-70386 **650-60-20**
Lewis Research Center Cleveland Ohio
30/20 GHZ SPACECRAFT MULTIBEAM ANTENNA TECHNOLOGY
R T Gedney 216-433-4000
(650-60-23 650-60-18 650-60-21 650-60-22)

The objective of this RTOP is to design fabricate and test proof of concept (POC) model antennas for 30/20 GHz wideband

communication satellites This effort will perform an investigation to evaluate and compare operational multibeam antenna system design concepts for a communications satellite select the best concept thereof and develop a detailed design for the best concept antenna system Emphasis will be placed on the system design concepts and technologies that maximize RF performance and degree of frequency reuse and minimize the complexity volume weight deployment techniques and costs The effort will breadboard and test critical technology components and will design fabricate and test a proof of concept model to demonstrate technology feasibility This technology will provide design data for flight hardware for 30/20 GHz demonstration systems to be flown in 1986 and 1988 and to evaluate antenna hardware elements needed for approaches that will be appropriate for operational satellites in the 1990s The antenna approach will be capable of providing up to eighteen (18) fixed spot beams for trunking application between major cities in addition to up to six (6) scanning beams for customer premise services Physical characteristics for the antenna system will permit packaging within the Shuttle vehicle envelopes

W81-70387 **650-60-21**
Lewis Research Center Cleveland Ohio
SATELLITE SWITCHING AND PROCESSING SYSTEMS
R T Gedney 216-433-6209
(650-60-23 650-60-18 650-60-20 650-60-22)

The objective of this effort is to develop the switching technology for the routing of signals (traffic) aboard multibeam multichannel 30/20 GHz wide band communications satellites Dual contracts for the design fabrication and testing of proof of concept (POC) models will be let in CY-80 in each of the following areas of satellite switching and processing intermediate frequency (IF) switch matrices for wide-band TDMA trunking applications switch matrices and filters for FDMA customer premise service (CPS) application and baseband switching and processing for TDMA CPS application These efforts which are planned for completion in CY-82 will provide proof of concept hardware and documentation technology readiness verification and design data for demonstration flights in 1986 and 1988 The objective of these flights is to demonstrate the technology for Ka band operational systems which will be implemented in the 1990s

W81-70388 **650-60-22**
Lewis Research Center Cleveland Ohio
COMMUNICATIONS SYSTEM COMPONENTS
R T Gedney 216-433-6209

The objective of this RTOP is to perform supporting research and technology development in the area of spacecraft transponders and transponder components including power amplifiers (tube and solid state) low noise receivers and other transponder components identified as needed in 30/20 GHz communications satellites system studies and to determine the ranges of applicability of various component design configurations as functions of performance requirements and physical characteristics e g volume weight power By means of principally a contractual program this RTOP will develop analysis and synthesis techniques for the above satellite components apply the developed techniques to determine the basic characteristics of components meeting specified requirements fabricate experimental components test and evaluate fabricated components perform proof of concept tests in house on a brassboard transponder for a selected approach using developed components in late FY-82

W81-70389 **650-60-23**
Lewis Research Center Cleveland Ohio
COMMUNICATIONS SYSTEMS BREADBOARD
R T Gedney 216-444-4000
(650-60-18 650-60-20 650-60-21 650-60-22)

The objective of this RTOP is to design and develop a breadboard model of a 30/20 GHz communications transponder to be used for compatibility and performance testing of subsystem developed for the 30/20 GHz Communications Program The transponder with appropriate input and output signals will simulate earth terminal to satellite to earth terminal communications links In-house design of a 30/20 GHz interim transponder utilizing state of the art components was completed in FY-80 and major components were purchased Testing and familiarization with the interim transponder will commence upon completion of fabrication of the transponder lab A proof of concept test transponder will be designed and fabricated which incorporates the technology development program POC subsystem hardware A simulation of the test transponder and POC subsystem hardware will be developed to predict test results and aid in test analysis System testing will be conducted to define the characteristics of both the complete transponder as well as individual POC subsystems The transponder will be updated as required to provide a test bed for analysis and trouble shooting of flight transponders

Data Management

W81-70390 **656-13-10**
Jet Propulsion Laboratory Pasadena Calif
OSTA DATA SYSTEMS STANDARDS AND GUIDELINES
J T Renfrow 213-354-9065
(656-13-40 656-13-60)

The objectives of this activity are to work cooperatively with Goddard Space Flight Center to achieve the definition of the standards requirements for OSTA programs and ADS pilots by interfacing with program representatives at Headquarters and other Centers and the Oceanic Pilot project within JPL and to perform a major role in the design of specific data system standards to coordinate with similar standards activities outside NASA in particular to foster future multi-Agency and international cooperative use of standardized Applications data to assist GSFC in the establishment of a standards implementation mechanism and finally to coordinate with the ADS Oceanic Pilot Project to implement the standards and guidelines These objectives will be pursued through the establishment of an OSTA Associate Standards Office at JPL staffed with data systems engineering experts which will work jointly with its counterpart at GSFC to achieve the definition of appropriate standards

W81-70391 **656-13-10**
Goddard Space Flight Center Greenbelt Md
OSTA/ADS DATA SYSTEMS STANDARDS AND GUIDELINES PROGRAM
Gerald Knaup 301-344-6034

The aim of this RTOP is to establish a program to provide effective standards and guidelines for OSTA/ADS data and data systems The general approach is to define and develop standards and guidelines for data catalogs data set formats and structures data system interfaces systems interconnection and where practical software obtain requirements by analyzing the data systems needs of the ADS pilots and key OSTA programs such as UARS NOSS and AgRISTARS in cooperation with the appropriate project or study offices specify evaluate and document key standards and guidelines in a controlled handbook series develop these standards and guidelines by identifying and building on the best current work and approaches such as the climate database catalog the Landsat image format family the ISO/ANSI/NBS computer network protocol standards programs and FIPS software documentation guidelines establish mechanisms to maintain the handbooks and provide for their dissemination review evaluation use and evolution and finally to coordinate standards and guidelines with similar activities within and outside of NASA such as OAST NEEDS OSTDS aerospace data systems standards NOAA NBS ANSI .and ISO Coordination among centers is particularly important

W81-70392 **656-13-20**
Goddard Space Flight Center Greenbelt Md
FULL SCALE APPLICATIONS DATA SERVICE (ADS) PLANNING STUDIES
Gerald Knaup 301-344-6034

This project will continue planning activities related to ADS development The objectives are (1) develop an approved statement of goals objectives and requirements for ADS from existing and planned OSTA and other programs key programs of other agencies and findings from ADS pilot systems studies (2) define a concept for orderly implementation of a full-scale integrated ADS (3) prepare a 10-year plan and supporting analyses to focus and direct ADS development The approach will be to initiate studies of ADS documentation and key OSTA

programs and identify requirements goals and objectives establish interfaces with NASA Headquarters NASA Centers and other external programs and integrate requirements and objectives into ADS planning define short and long range goals and objectives of ADS and prepare plans requirements schedules work breakdown structures and cost estimates for ADS development define the concept for full-scale ADS implementation and prepare a 10-year plan for total ADS Program and update the plan upon pilot systems study results

W81-70393 **656-13-30**
Goddard Space Flight Center Greenbelt Md
APPLICATIONS DATA SERVICE (ADS) ATMOSPHERIC PILOT SYSTEM
Gerald Knaup 301-344-6034

This program will define implement and evaluate an evolutionary ADS pilot system in the atmospheres discipline and Provide (1) and ADS-type network useful for selected OSTA-related Atmospheric users/programs (2) a test bed for the ADS Porgram to demonstrate and evaluate alternative standards and advanced data handling concepts and (3) a base from which a future full-scale ADS can evolve The approach will be to continue and extend FY-80 initiated cooperative efforts with SSRP VAS Demo Climate Research and UARS atmospheric discipline programs to explore evaluate and demonstrate improved capabilities for linking data users and data producers and to utilize and augment existing atmospheric data systems such as the AOIPS and GSFC and Wisconsin VAS Processors to serve as test beds to develop and demonstrate ADS concepts Emphasis will be given to (1) data catologing data access and data delivery capabilities to improve user access to atmospheric related data (2) and techniques such as SNAP for interconnecting data systems and data bases to improve atmospheric data sharing capabilities

W81-70394 **656-13-40**
Jet Propulsion Laboratory Pasadena Calif
ADS OCEANIC PILOT SYSTEM PROJECT
E A Gardner 213-354-9028
(656-45-02 656-31-02 656-13-60)

The objectives of this activity are to (1) evaluate design and implement the appropriate computer and information technologies standards and applicable products for an oceanic information pilot system (2) develop a thorough understanding of the information systems needs of the OSTA oceanic research community by demonstrating developed capabilities and (3) coordinate phases of the Oceanic Pilot System development with the other pilot systems related NASA End to End Data System (NEEDS) efforts and the Applications Data Service (ADS) planning studies These objectives will be pursued through the design development and operation of the Oceanic Pilot System This system will provide selected researchers in the oceans remote-sensing community with computerized access to satellite and conventional data sets It will offer users state-of-the-art facilities for data communications management cataloging remote access data base sharing and networking This pilot system possessing many of the attributes of the OSTA Data System/Applications Data Service (ADS) will serve as a test-bed for the development and analysis of key information system capabilities This effort will be coordinated with the activities of the Oceans Data Utilization Study (RTOP 656-13-60) and will act as test-bed for that study

W81-70395 **656-13-60**
Goddard Space Flight Center Greenbelt Md
OCEANIC DATA UTILIZATION SYSTEM STUDY
David Howell 301-344-9041

This program will investigate user requirements for the ingest manipulation management display integration and analysis of data from ocean monitoring systems and make recommendations for needed capabilities to meet those requirements A study will be initiated to investigate and evaluate user requirements produced by the ICEX NOSS and TOPEX Science Working Groups Alternative data systems concepts will be defined based on user requirements available facilities and Goddard experience in development of capabilities such as AOIPS for ingest management analysis and display of applications data Recommended approaches for Oceanic Data Utilization System development will take full advantage of Goddard work in support of weather and climate ADS and related programs

W81-70396 **656-13-70**
Jet Propulsion Laboratory Pasadena Calif
ADS PILOT GEOSCIENCES INFORMATION NETWORK DEVELOPMENT
J R Huning 213-354-9358
(656-13-40 656-13-02 656-33-01)

The purpose of this RTOP is to test the Applications Data Services (ADS) concept of a common catalog for available data by design of a pilot system for the distributed geosciences data bases The three objectives of this activity for FY-81 are to (1) define and analyze methods currently used in the management of distributed data catalogs in the geosciences (2) define user requirements for access to distributed data bases in the geosciences community and (3) design a pilot Geosciences Information Network (GIN) for exchange of catalog information that points to geosciences data The objectives will be accomplished by performing three major tasks The first task is identification of applicable OSTA/NASA and related data bases for the geosciences and the preparation of a coordinated and prioritized summary for each data base including current status location and access method The second task in the performance and documentation of a user requirements analysis This task builds upon the FY-80 JPL study in the crustal dynamics area and expands consideration of data bases to the related and significantly larger geosciences disciplines The third task is the design of a pilot GIN system with the data bases to remain in the existing wide variety of hardware used for data management and under control of the present data base managers

W81-70397 **656-31-02**
Jet Propulsion Laboratory Pasadena Calif
APPLICATIONS DATA BASE MANAGEMENT SYSTEM (ADBMS)
Guy M Lohman 213-577-9291
(656-13-40 520-73-05)

The objective of this study is to develop the functional requirements for data management operations that are common to most users of OSTA and related data bases and to procure or develop the software necessary to meet those requirements The functional requirements will evolve from successive in-depth analyses of representative existing data bases their current data management systems users and those missions or other sources who supply the data Primary emphasis will be upon the tools needed by users to access and manipulate data Data collection from available literature and interviews with data managers users and data suppliers will be analyzed to determine what functions should be performed by a generalized data base management system (DBMS) An assessment of the characteristics of current and projected data types will determine other functional requirements upon the DBMS Finally existing standards relevant to an OSTA DBMS will be compiled and evaluated for possible inclusion into the requirements The results will be reviewed by two workshops one early in the fiscal year to review preliminary results and the methodology used the second late in the fiscal year to review final results and a plan for development and implentation Then in FY-80 a feasibility analysis will determine the most cost effective source of each DBMS component followed by a period of procurement and/or development of each component Finally the components will be integrated and implemented for testing in a distributed pilot configuartion

W81-70398 **656-33-01**
Jet Propulsion Laboratory Pasadena Calif
AUTOMATED MOSAICKING FOR GEOCODED DATA BASES
Albert L Zobrist 213-354-3237

The goals of the tasks described herein include (1) reducing the cost of performing digital geometric transformation and mosaicking (2) developing transportable procedures for producing computer mosaics from digital frames of Landsat and other sensors processed by the GSFC Master Data Processor and (3) developing transportable general purpose mosaicking and geocoded data

base interface software designed to provide multi-sensor and multi-temporal registration of multiple scenes at minimal cost Such procedures should permit Landsat digital users to no longer be constrained by the framing convention used for Landsat and potentially achieve greater economies of scale in thematic mapping and enhanced image interpretation by extending their analysis over much larger areas Moreover, they should facilitate the spatial integration of other satellite imaging systems having various pixel sizes orbit declination and image swath areas (e g HCMM Seasat SAR) Finally the integration of previously developed software and procedures to register and compare image and graphical files will provide the means to automatically register non-NASA geocoded data bases with imaging data thereby bringing NASA data into the mainstream of data processing at minimal cost The specific objectives of this proposed research are oriented toward the development of algorithms and associated software modules and systems integration to (1) extend the MDP temporal registration and geometric correction to multiple-frame Landsat digital mosaics at standard map projections (2) achieve an automated geobase (e g nominal/ordinal) interface with the MDP output of Landsat digital images (3) the software and procedures developed to selected test cases The test cases include ongoing research programs being undertaken by the Image Processing Laboratory thereby capitalizing on the current results for comparison with the developed technology

W81-70399 **656-45-02**
Jet Propulsion Laboratory Pasadena Calif
RESISTRATION OF RADAR AND OTHER DATA
Richard J Blackwell 213-354-5677
(656-13-01)

The objectives of this task are to develop a series of data and image processing techniques which will permit the registration merging overlaying and display of remotely sensed and in-situ oceanic data The techniques developed will be tested and evaluated by the oceans user community with the Oceanic Data Utilization System (ODUS) The ultimate goal of this task is to provide the ocean science data user the methods and means to assemble multi-layered data sets of oceanic data The data sets may consist of sensor outputs from a number of ocean viewing satellites such as Seasat NIMBUS-7 TIROS and the NOAA series Also included will be the ability to include in-situ information as another information component The results of this technology development task will be evaluated by the ocean science data user community in cooperation with the ADS Oceanic Pilot System Project A series of studies limited to specific goals will be planned and phased The studies will be directed toward the development of technologies and methodologies which will enable the registration of multi-sensor satellite data These data may represent overpasses at different times from the same satellite or from different satellites The procedure to be followed after data acquisition and establishment of the characteristics of sensors will be largely (1) geolocation of the data (2) selection of scale (3) alteration of data to selected scale (4) geometric transformation and registration to a planometric base and (5) application of existing techniques such as differencing to characterize accuracy

W81-70400 **656-62-01**
Jet Propulsion Laboratory Pasadena Calif
SYNTHETIC APERTURE RADAR PROCESSOR
Raymond G Piereson 213-354-3322
(677-36-01 506-61-15)

The general objective of this RTOP is to develop high-throughput synthetic aperture radar (SAR) data processor technology to meet the requirements of future space missions This will be accomplished as follows (1) the hardware and software of the interim digital processor will be upgraded This will increase the throughput rate by approximately a factor of five This will enable a 100 Km x 100 Km Seasat image exhibiting 25 m resolution at four looks to be processed in approximately two hours This upgrade will be completed during FY-81 (2) an advanced digital SAR processor (ADSP) utilizing the technology expected to be available in the mid 1980 s will be developed A ground based engineering model ADSP will be developed by the end of FY-85 This processor will have the capability to process Seasat SAR data at the real-time acquisition rate (3) research into processor architectures adaptive process control techniques and SAR processing algorithms will be performed This work will enable further advances in SAR processors and enable an increase in the amount of information obtained from SAR imagery Tasks 1 and 3 will be performed in-house at JPL Task 2 will be performed by contractors with direction from JPL

Regional Application Transfer Activities

W81-70401 **663-90-03**
Jet Propulsion Laboratory Pasadena Calif
COMMERCIAL FISHERIES OCEAN FORECAST DEMONSTRATION
D R Montgomery 213-354-2339

This activity will broaden and extend the fisheries support experiment in the Seasat Commercial Demonstration Project by developing new fisheries products based upon remote ocean sensing and then demonstrating their utility through real-time broadcast to fishermen at sea The objectives are (1) to collect Northeastern Pacific satellite data which are of interest to fisheries (2) develop new (tailored) fisheries products which merge satellite information and conventional numerical analyses/forecasts of environmental parameters (3) distribute these products to fishermen using the existing Satellite Data Distribution System (SDDS) and cooperating radio broadcast stations and (4) affect technology transfer back to NASA in the areas of sensor accuracy optimum orbital configuration data processing product transmission/display and economic benefits

Geodynamics

W81-70402 **676-10-10**
Goddard Space Flight Center Greenbelt Md
REGIONAL CRUSTAL DEFORMATION MODELING
R J Allenby 301-344-6523
(677-45-01 676-30-01)

The objective of this RTOP is to conduct studies of geophysical models of crustal deformation of geodetic data obtained under NASA s Crustal Dynamics Project and to determine types and accuracies of other ground-based measurements and ancillary data significant to interpreting regional tectonic processes This RTOP will develop models of earthquake mechanisms fault motions and regional tectonics in active seismic areas interpret and improve these models using VLBI and laser ranging measurements as they become available and improve our understanding of the earth s rheology and spatial differences of seismic energy release from region to region Specific areas of study include the eastern U S with emphasis on the central and southern Appalachians and the Basin and Range/San Andreas Fault zone relationship

W81-70403 **676-30-01**
Goddard Space Flight Center Greenbelt Md
GLOBAL EARTH DYNAMICS AND STRUCTURE
D E Smith 301-344-8555

The objective of this RTOP is to improve our understanding and knowledge of the dynamics of the earth by development of models of polar motion and earth rotation global plate motion mantle convection plate driving mechanisms the dynamics of the core and earth tides and to improve our knowledge and understanding of the global structure of the earth its interior properties its crustal magnetization the gravity field and its anomalies and the evolution of the lithosphere and crust Theoretical and numerical studies will be conducted of the density structure stress and rheology of the mantle and properties of the lithosphere based on gravity altimetry tracking and supporting geophysical data The dynamic processes at convergent plate boundaries will be modeled and investigated and also the early evolution of the crust resulting from major impact bombardment In addition the tidal perturbations of satellites will be used for the estimation of earth and ocean tidal amplitudes and phases The RTOP addresses the following major problems (1) the understanding of the processes and mechanisms of plate motion and mantle convection (2) the properties and evolution of the lithosphere and (3) the deformation of the earth by tidal forces

W81-70404 **676-40-01**
Goddard Space Flight Center Greenbelt Md
GEOPOTENTIAL FIELD MODELS
D E Smith 301-344-8555

The objectives of this RTOP are the development of gravity and magnetic field models and associated analytical methods data analysis techniques and supporting software systems From the analysis of satellite tracking data in conjunction with satellite altimetry and surface measurement data models of the earth s gravitation field shape and size will be derived Global models in both gravity anomaly and geoid height representation will be developed down to wavelengths of about 100 km More accurate and reliable field models of the earth s main magnetic field and its secular variation will be derived from satellite and surface data and techniques developed for separating the field according to its source The development of the software systems to support the gravity and magnetic field modeling activities will be continued This RTOP supports the following program areas (1) the development of models of the earth s interior structure (2) the development of lithospheric models (3) the determination of the ocean geoid for oceanography (4) the investigation of core motions and dynamics and (5) the use of magnetic and gravity data for resource assessment

W81-70405 **676-59-30**
Goddard Space Flight Center Greenbelt Md
ADVANCED GEODYNAMICS STUDIES
W D Kahn 301-344-8554

The objectives of this RTOP are (1) to define develop and evaluate design strategy for an airborne laser ranging system suitable for regional monitoring of crustal deformation and other earth dynamics phenomena and (2) to study and define instrumentation orbit geometry and coverage mission life-time for monitoring the secular variation and decay of the earth s main magnetic field Studies will be made to determine measurement accuracy rate and geometry requirements for an airborne laser ranging to ground emplaced retro-reflectors for detection and monitoring of small earth surface motions Alternative near-earth magnetic field missions will be evaluated Emphasis is to be placed on determining a mission profile which optimizes new information regarding the earth s main magnetic field

W81-70406 **676-59-33**
Marshall Space Flight Center Huntsville Ala
SUPERCONDUCTING GRAVITY GRADIOMETER
E W Urban 205-453-5132

The objective of this RTOP is to demonstrate the feasibility of a three-axis superconducting gravity gradiometer for space flight that is capable of measuring gravity gradients along three mutually perpendicular axes with a sensitivity of 0 001 EU or better A single axis unit will be completed and tested and a three axis engineering unit will be designed fabricated tested and refurbished for a possible Shuttle test flight

W81-70407 **676-59-35**
Goddard Space Flight Center Greenbelt Md
LASER/VLBI PROPAGATION MEDIUM ANALYSIS
J B Abshire 301-344-8948
(506-61-56)

The overall objective of this RTOP is to evaluate the accuracy of existing atmospheric models used with laser ranging systems It represents the Goddard effort of a joint Goddard/JPL program to analyze propagation medium effects in laser and VLBI systems The specific program objectives for this RTOP are as follows (1) develop instrumentation techniques for atmospheric refractivity measurements (2) carry out extensive tests over horizontal paths to validate the accuracy of the measurement system and (3) carry out ranging tests over slant paths to aircraft to evaluate the accuracy of models The technical approach for this effort is (1) to develop a multiwavelength ranging system to measure integrated air density along the ranging path (2) evaluate the use of highly sensitive angle tracking devices as an independent technique to measure atmospheric refraction gradients and (3) use data obtained from approaches one and two to measure the accuracies of existing atmospheric models

W81-70408 **676-59-37**
Jet Propulsion Laboratory Pasadena Calif
LASER/VLBI PROPAGATION MEDIUM ANALYSIS
G M Resch 213-354-4786

The objective of this RTOP is to determine the total atmospheric delay (both dry and wet components) with sub-centimeter accuracy This information will be used to assess the effects of gradients and fluctuations in the refractive index on the possible centimeter level performance of laser ranging and VLBI systems The measurements of the wet delay will be used to evaluate the accuracy of the water vapor radiometer technique We will design construct and test a three-color ranging device (two optical signals and one microwave signal) that we can use to range to an aircraft If the aircraft is at an altitude of 6km or more we should be able to measure 95% of the wet delay and over 50% of the dry delay As the aircraft flies various patterns around and over the ranging site we should be able to measure horizontal gradients and their temporal stability We will simultaneously look along the line of sight to the aircraft with a water vapor radiometer and make an independent estimate of the total water vapor content In addition we will test the ability of the WVR to track fluctuations of water vapor and provide a calibration to an interferometer by taking two WVR s to the site of the very large array Real-time comparisons will be made between water vapor and interferometer phase on baselines up to 21 km The instrumentation in both laser ranging and VLBI systems appears capable of cm level performance However system accuracy will be limited by other systematic error sources such as uncalibrated tropospheric delay It is imperative to evaluate the magnitude of these tropospheric effects and to evaluate the techniques that we might use to reduce them

W81-70409 **676-59-41**
Marshall Space Flight Center Huntsville Ala
SHUTTLE TIME AND FREQUENCY TRANSFER EXPERIMENT (STIFT)
R Decher 205-453-5130

The objective of this RTOP is to define a demonstration experiment using a hydrogen maser clock onboard the shuttle for world wide time and frequency transfer with accuracies in the nanosecond range or below Microwave and laser signals will be transmitted between the space vehicle and a ground station to compare the space clock with a ground clock Other organizations participating in the study include USNO NBS SAO and the University of Maryland

Resource Observations Applied Research and Data Analysis

W81-70410 **677-21-06**
National Space Technology Labs Bay Saint Louis Miss
INTEGRATION OF VIS-IR-NW DATA
S T Wu 601-688-3830

The basic objective is to evaluate the results of having combined data acquired with multispectral scanners and synthetic aperture imaging radars relative to deriving improved land resource inventory information The established approach as outlined below will be continued with the goal of completing the associated analysis evaluation and documentataion by the end of FY-81 The objectives are to (1) derive land resources information from multispectral scanner (MSS) digital data acquired over a variety of terrain types by Landsat (2) derive land resources information from synthetic aperture radar digital data acquired by Seasat and aircraft over the same test sites for which Landsat data was processed (3) derive land resources information from a digital data set produced by merging synthetic aperture radar (SAR) data and Landsat MSS data used for (1) and (2) and (4) evaluate the results with respect to the number types and accuracy of land cover/vegetation classes derived by processing SAR data and Landsat MSS data independently and compare these results with those produced from processing the merged SAR-MSS digital data sets

W81-70411 **677-21-20**
National Space Technology Labs Bay Saint Louis Miss
SURFACE MINE REHABILITATION INVENTORY AND MONITORING
Dale Quattrochi 601-688-3830
(677-21-06)

The project objective is to determine and analyze what information pertinent to the inventory planning and monitoring of surface mine rehabilitation can be derived from spacecraft-acquired data An evaluation will be made of how the optimum sensor system or systems spectral and spatial resolution, and season can be combined with a geographic data base to identify and monitor surface mining reclamation activities The technical approach will be to analyze data acquired over abandoned active or recently rehabilitated surface mines within study sites in eastern and western Kentucky Data collected by existing spacecraft sensor systems will be assessed in conjunction with data obtained through simulating spectral spatial and radiometric properties of future spacecraft sensor systems Particular emphasis will be placed on analyzing the improved resolution capabilities of the Landsat-D Thematic Mapper relative to the Landsat Multispectral Scanner All of the remotely sensed data for this research will ultimately be evaluated on how much information each sensor contributes and how the integration of the various sources of data through a geographic information system enhances the utility of remotely sensed data for surface mine rehabilitation inventory and monitoring

W81-70412 **677-21-22**
Ames Research Center Moffett Field Calif
ALASKA WETLANDS DELINEATION PROGRAM
D E Wilson 415-965-5897

An RTOP is proposed to develop and test several techniques of Landsat digital and computer-aided visual analysis for distinguishing wetlands from non-wetlands cover types in Alaska Test sites representing various physiographic regions of Alaska will be studied in order to develop a wetlands delination model that will apply so far as is possible over the majority of the State The project objectives will be met through the following approach Initially an assessment of agency needs concerning wetlands information will be conducted along with derivation of a uniform definition of wetlands Physiographicalyy different test sites will then be chosen and ground-truthed To analyze these sites several techniques will initially be employed Among these are use of multi date imagery band ratioing straatification and ancillary data It is anticipated that at least two of the three following Landsat data systems will be employed in this effort ARPANET/EDITOR IDIMS VICAR/IBIS All results and recommendations forthcoming will be evaluated and tested in the broadest environment to determine extent of applicability Comparisons will be made with results of integrated terrain unit mapping in the Susitna River Valley

W81-70413 **677-22-12**
Ames Research Center Moffett Field Calif
REMOTELY-SENSED ELECTROMAGNETIC CHARACTERISTICS OF SNOW AND SOIL MOISTURE
W I Lindor 415-965-5538

The long-range objective of this activity is the development of microwave remote sensing techniques for the measurement of the areal extent depth density and wetness of snowpacks employing surface systems aircraft and satellite vehicles Such information is needed to assess snowpack mass and runoff regimes for flood forecasting Immediate objectives of the RTOP include investigation of the electromagnetic characteristics of natural snowpacks (dielectric constant attenuation and layering) radar backscatter properties and development of surface systems to provide ground-truth data The surface systems have the additional objectives of providing data for assessment of watershed resources on a time progressine basis operated automatically in DCP installations including measurement of soil moisture utilizing microwave techniques The apporach consists of measuring the phase shift and attenuation as functions of frequency in the range of 2 to 18 GHz for in-situ snow and for samples Radar backscatter is investigated as functions of frequency angle of incidence polarization and snow layering Calibration involves use of dry snow to which known amounts of water have been added Soil wetness is investigated by measurement of phase shift and attenuation for in-situ assemblies and for samples

W81-70414 **677-27-04**
Jet Propulsion Laboratory Pasadena Calif
RADAR SPECTROMETER
W E Brown Jr 213-354-2110

The objective of this RTOP is to develop a very wide band radar system to measure surface radar backscatter as a function of wavelength The long-range objective is to complete a system that covers the radar wavelength range of 30 cm to 3 mm (frequency range 1 GHz to 100 GHz) The short-range objective is to cover the range 15 cm to 1 7 cm (2 to 18 GHz) In FY-80 this RTOP will complete the development of the 2 GHz to 18 GHz system and conduct engineering testing In FY-81 it will augment the system with modulation and 1 watt CW traveling wave tubes as necessary conduct field tests with users involved with geology and agricultural experiments to evaluate the system performance and carry out a system design study to mount the spectrometer on a helicopter to generate functional specifications

W81-70415 **677-29-04**
Goddard Space Flight Center Greenbelt Md
GRAVITY FIELD SURVEY MISSION (GRAVSAT) PHASE B STUDIES
Samuel Bergeson-Willis 301-344-8566

The objective of this RTOP is to become fully prepared for a new start for the GRAVSAT mission in FY-82 from an engineering scientific fiscal and management point of view Mission objectives for GRAVSAT are the determination of gravity with an accuracy of 1 milligal in 1 deg x 1 deg squares globally and the determination of geoid height to 10 cm for wavelengths between 100 km and 3000 km A definition phase study for GRAVSAT will be conducted Specific tasks to be accomplished and milestones are to define subsystems in sufficient detail to insure their technological readiness and to continue the development of a brass board of the Satellite-to-Satellite Doppler Tracking System to demonstrate technology readiness for GRAVSAT (September 1981)

W81-70416 **677-29-06**
Goddard Space Flight Center Greenbelt Md
DEMONSTRATION FLIGHT SYSTEM AND OPERATIONAL LAND OBSERVING SYSTEM (OLOS)
Enrico P Mercanti 301-344-7889

The objective of this RTOP is to support the National Oceanic and Atmospheric Administration (NOAA) in the definition and development of the demonstration flight system and the Operational Land Observing System (OLOS) which was mandated by Presidential Directive PD/NSC-54 in November 1979 This RTOP will perform Phase A mission tradeoff studies for the demonstration flight system and the OLOS conduct technical and feasibility analyses establish schedules estimate costs and assess risks pertaining to alternative space and ground segment configurations All tasks will be performed in compliance with interagency-stipulated user data product requirements and in close coordination with NOAA the R&D User Working Group and the OLOS Operational User Working Group

W81-70417 **677-29-09**
Goddard Space Flight Center Greenbelt Md
PHASE B STUDIES - LANDSAT SOLID-STATE SENSOR (LS3)
Leslie L Thompson 301-344-8107
(677-37-01)

The objective of this RTOP is to develop detailed design options and set of specifications for potential instruments that provide both a demonstration of the advanced technology associated with multi-spectral linear arrays (MLA) and the prototype of the potential sensor for the Operational Land Observing System Based on the definition of user requirements developed by an R&D User Working Group and the Operational User Working Group and the results of FY-80 MLA Phase A studies GSFC will initiate competitive Phase B studies with two

contractors In parallel with the contractor studies GSFC will perform parametric systems analyses to validate the relative merits of each of the contracted studies A detailed plan and RFP for Phase C/D will be prepared This RTOP supports the following programs (1) Landsat (2) shuttle payload, and (3) Operational Land Observing System These in turn support the following objectives (1) agricultural and mineral resources (2) environment and (3) disaster assessment

W81-70418 **677-41-02**
Jet Propulsion Laboratory Pasadena Calif
NASA/GEOSAT TEST CASE STUDY
Michael J Abrams 213-354-6927
(677-41-03 667-41-04)

The primary objectives are to (1) demonstrate that useful information for geologic mapping can be derived from currently available remote sensing techniques (2) evaluate the utility of current remote sensing technology for mineral/hydrocarbon exploration and (3) develop recommendation for the design of future aircraft/spacecraft remote sensing systems that could supply data to meet the requirements of exploration geologists The approach is to perform the following activities in conjunction with the Geosat Committee Inc (1) complete the FY80 project involving selected test sites in regions of known uranium copper and hydrocarbon occurences and produce a final report (2) follow-on uranium study to examine regional alteration in the Glen Canyon Series rocks associated with uranium occurences local alteration associated with uranium deposits such as at Temple Mtn Utah and determine the correlation (if any) with regional alteration and spectral and mineralogical characteristics of an exhaustive suite of rock sample from worldwide uranium deposits will be developed (3) a test case project will be established for volcanogenic massive sulfide deposits Two phases will be started in parallel one to study deposits in the U S and the other in Australia Sedimentary basins in the U S will be studied for regional and local structural and lithologic control on hydrocarbon formation migration and emplacement Other commodities and/or deposits will be identified for study based on economic factors and national needs For each a test case study will be initiated in conjunction with Geosat members and personnel from academia and other government agencies similar to the projects already ongoing for copper uranium and hydrocarbons

W81-70419 **677-41-04**
Jet Propulsion Laboratory Pasadena Calif
ROCK TYPE/MICROWAVE TECHNIQUES (IMAGING RADAR GEOLOGY)
Charles Elachi 213-354-5673

The Seasat SAR was the first step in developing our capability to observe the Earth s surface with an active microwave sensor from space Other experiments will be conducted in 1981 (the Shuttle Imaging Radar-A Sir-A) In order to be able to analyze the data from these experiments and plan future ones it is essential to understand the radar signature of surface features as a function of the radar parameters (frequency observation geometry polarization) and the interaction of the radar waves with the surface This proposal is directed toward these objectives The proposal covers all the research effort at JPL in the area of radar geology for the three-year period of FY-81 FY-83 It represents the efforts of a team of eleven researchers who will be addressing different aspects of the radar geology activity with the common objective of understanding the information in radar images and developing techniques to use them in conjuction with other remote sensing data to further our understanding of the Earth s surface geology

W81-70420 **677-41-08**
Jet Propulsion Laboratory Pasadena Calif
HIGH SPECTRAL RESOLUTION REMOTE SENSING
Anne B Kahle 213-354-7265
(677-41-03 677-42-01)

The research objectives are to complete the computer and other analyses of high spectral resolution aircraft data The analysis will be aimed primarily at extracting information from the new high resolution data in 1 4 micrometer to 2 5 micrometer region The information sought is (1) characteristics of the clay and carbonate bands in the 2 0 micrometer to 2 5 micrometer region (2) properties of vegetation canopies in the 1 1 micrometer to 2 5 micrometer region (3) optimum spectral bands in these regions and (4) the noise problems in the IR region Reference spectra of known rock sample will be taken in the laboratory These curves will be compared with the field data using various pattern recognition techniques Many of these techniques will be tested during the research Vegetation spectra will be analyzed using waveform analysis methods developed to detect spectral differences among the data The differences sought in particular are those that are associated with mineral deposits Various spectral bands will be simulated in the aircraft data and tested for optimum width spectral position and number of bands required for scanner survey applications The aircraft field data will be put into the band models to evaluate ground-induced noise effects that will be found in scanner data

W81-70421 **677-41-09**
Jet Propulsion Laboratory Pasadena Calif
GEOLOGICAL MAPPING KILAUEA CALDERA STRATIGRAPHY
Michael J Abrams 213-354-6927

The objective of this proposal is to define and characterize the strategraphic units in the wall of Kilauea Caldera Hawaii This information is important to help decipher the prehistoric eruptive history of one of the classic volcanic complexes on Earth and provide a better basis for predicting future eruptions A novel observational technique will be used Because of the inaccessibility of the site remote sensing techniques (reflectance spectroscopy and multispectral mapping) will be applied along with some direct sampling and laboratory sample characterization Existing astronomical laboratory instrumentation will be modifed for terrestrial use Laboratory characterization of accessible rock sample will be conducted both spectrally and by more conventional petrological methods to determine the most productive spectral regions for field measurement A program of in-the-field spectroscopy and multispectral imaging will be designed and carried out with emphasis on calibrations and aspects of observing which are unique to terrestrial applications As observational data are obtained and reduced they will be analyzed to determine the optimum ways to map compositional units in Kilauea and this mapping will then be initiated

W81-70422 **677-41-11**
Lyndon B Johnson Space Center Houston Tex
THEORETICAL STUDIES OF RADAR BACKSCATTER
A W England 713-483-2411

The objective of this RTOP is to develop theoretical models which accurately describe the volume scattering of incident microwave radiation within natural surface media such as forest canopies ice and snow and lunar and planetary regoliths This RTOP will (1) extend existing capability to perform numerical backscattering calculations employing the Mie scattering approximation (2) develop new algorithms to perform such calculations employing Kirchoff s method (3) develop realistic geometric representations of natural materials for incorporation in theoretical models and (4) compare numerical (model) results with experimental (empirical) backscattering measurements

W81-70423 **677-41-12**
Lyndon B Johnson Space Center Houston Tex
ANALYSIS OF MULTIFREQUENCY/MULTIPOLARIZATION SAR IMAGERY
M B Duke 713-483-4464

The objective of this RTOP is to (1) determine information gained from analysis of multifrequency/multipolarization data compared with single frequency/polarization imagery and (2) determine information added by combining multifrequency/multipolarization SAR data with multispectral VIS-IR data This will be accomplished by Synthetic Aperture Radar (SAR) (1) registering multifrequency/multipolarization A/C SAR data for a region around Flagstaff Arizona (2) applying image enhancement techniques (edge enhancement filtering channel rationing etc) to multichannel radar imagery (3) registering other remote sensing data to SAR imagery and applying image enhancement techniques

and (4) evaluating geological information gained by multichannel SAR data alone and in conjunction with VIS-IR data

W81-70424 **677-42-01**
Goddard Space Flight Center Greenbelt Md
GEOBOTANICAL TEST SITE INVESTIGATIONS
mark Labovitz 301-344-4928

The objectives of the geobotanical field project conducted at NASA/ Goddard Space Flight Center are (1) to determine the utility of different spectral bands for mapping the geobotanical anomaly over a known metal sulfide deposit (2) to determine the best spatial resolution for mapping the anomaly (3) to determine the best temporal window for mapping the anomaly (4) to assess the reproducability of spectral biogeochemical and geobotanical measurements within the anomalous area over several growing seasons and (5) to select other geobotanical anomalies more complex than the first on which to evaluate the general applicability of the above determinations In FY-81 to FY-83 the objective will be to 1) select a series of field sites of increasing topographic and botanical complexity commencing with the least complex site in Mineral, Virgina 2) collect relevant ground truth a several spatial scales on a square sampling grid at monthly intervals throughout the growing season 3) simultaneously collect remote sensing data in spectral bands suggested by previous research and 4) use data to perform analyses which have as their major factors complexity spatial scale and time

W81-70425 **677-43-01**
Lyndon B Johnson Space Center Houston Tex
TERRAIN MODELS FOR SAR DEVELOPMENT
M B Duke 713-483-4464
(677-41-04 677-41-11 677-41-12)

This investigation is developing the capability to evaluate optimal design parameters for synthetic aperture radar systems in geological applications Simulation models will allow the effects of selecting antenna depression angles frequency polarization look direction resolution and other factors of satellite SAR systems on the detection and characterization of geological features In turn the procedures will allow criteria to be developed for systematic characterization of landforms based on SAR data The approach is to (1) develop computer simulation models of natural terrain employing progressively more complicated geometrical descriptions of surface landforms (2) model the backscattering response (backscatter coefficient polarization etc) of individual elements in the geometrical representations and synthesize artificial SAR images for these representations (3) compare computer synthesized SAR images with aircraft radar imagery available over selected test sites to verify simulation models and (4) to test the effects of varying SAR system parameters on the simulated imagery and determine the optimum system configuration for landform identification

W81-70426 **677-43-03**
Lyndon B Johnson Space Center Houston, Tex
TECTONIC STRUCTURE IN PAKISTAN
W C Phinney 713-483-3816

The objectives are to (1) employ LANDSAT MSS and RBV imagery in identifying tectonic structural features of recent geological age within Pakistan including active faults broken fault segments basin subsidence uplift and active fold belts and (2) prepare a comprehensive map of recent tectonic structures within Pakistan The objectives will be accomplished by (1) compiling LANDSAT MSS mosaic of study area to serve as structural base (2) obtaining supporting enhanced imagery RBV imagery aerial photography geophysical survey data and ground based measurement and register these other data sets to the LANDSAT base map (3) identifying major structural features in LANDSAT imagery and examine the expression of such features in ancillary data sets, (4) collaborating with Pakistan geologists to verify results of imagery analysis and (5) compiling detailed studies of regional districts into comprehensive tectonic map

W81-70427 **677-43-05**
Lyndon B Johnson Space Center Houston Tex
INTEGRATED STUDY OF CONTINENTAL RIFT SYSTEMS
D P Blanchard 713-483-2781

The objectives are (1) to construct models for the formation and evolution of the Rio Grande Rift (RGR) and for the development of resources associated with it (2) to constrain and enhance these models by use of space acquired data in conjunction with ground based and aircraft data (3) to apply models to technique development for resource evaluation (4) to develop techniques for using remote sensing data (R-S) to study structure composition and evolution of large crustal features and (5) to develop requirements for future remote sensing systems for spacecraft The approach is (1) to identify experts for RGR region and establish a working group (2) to identify the major scientific problems associated with the RGR (3) to propose topical research areas to bring together classical and R-S techniques on significant problems (4) to assemble data bases appropriate to the topical problems (5) to carry out coordinated research and multidiscipline modeling on topical problems and (6) to evaluate impact of R-S on modeling process

W81-70428 **677-44-01**
Jet Propulsion Laboratory Pasadena Calif
PIPELINE/NUCLEAR PLANT ENGINEERING GEOLOGY
Harold Lang 213-354-3440

The objectives are to assess the utility of LANDSAT imagery (MSS and RBV) in evaluating environmental hazards and engineering factors involved in major energy related construction projects and to compare costs for site selection studies employing satellite imagery analysis with those for similar studies using conventional studies The approach is to (1) complete LANDSAT 3 data base for selected engineering projects (primarily the Northern Tier Pipeline Project extending from the state of Washington to Minnesota) (2) identify features of engineering interest (landslides fault traces subsidence cracks sand and gravel deposits etc) (3) compare location size and spatial density of engineering features identified on satellite imagery with ground truth data (4) evaluate accuracy and limitations of LANDSAT RBV and MSS imagery for engineering investigations and (5) determine net difference in time and costs required for engineering studies using currently available space-acquired data

W81-70429 **677-45-01**
Goddard Space Flight Center Greenbelt Md
CRUSTAL MODELING USING SATELLITE POTENTIAL FIELD DATA
P T Taylor 301-433-5600

The ojective of the RTOP is to develop methods of applying satellitederived magnetic and gravity data together with other geologic information to the study of structure and composition of selected geologically important large regions of the Earth s crust Magsat and POGO satellite magnetic anomaly maps will be constructed for geologically significant structures on a global scale These magnetic anomaly maps will be interpreted by means of vector and scalar anomaly representation by suitable mathematical models which reflect the known geology and structure of a region under study These models will provide some indication of the geological structures producing the anomalies One of the worldwide rift structures has been selected for detailed investigations the Rio Grande Rift system Other areas of either significant resource potential or geological interest have been chosen for detailed study the Texas Panhandle region and the largely unknown Arctic region The RTOP supports the following major programs (1) non-renewable resources (2) geodynamics and (3) technology transfer These in turn support the following end objectives (1) plate tectonics (2) regional geophysics and (3) resource assessments

W81-70430 **677-45-03**
Goddard Space Flight Center Greenbelt Md
PETROLOGIC AND GEOPHYSICAL STUDIES OF THE SOURCE OF LONG WAVELENGTH CRUSTAL MAGNETIC ANOMALIES
H H Thomas 301-344-5412
(677-45-01 677-45-04 667-45-06)

The objectives are (1) to further our ability to interpret Magsat and POGO magnetic anomlay data through development of our understanding of the magnetization and pertrology of rocks which make up the earth s magnetic crust (2) to model, quantitatively the magnetic fields produced at aircraft and satellite altitudes by the determined abundance and spatial configuration of these subsurface rock bodies and (3) to develop schemes for the evolution of magnetic mineralogy which provide chemical and physical constraints on the formation of rocks and minerals of resource interests The RTOP will determine magnetic and pertrologic properties of xenolithic rocks characteristic of the earth s crust and upper mantle Petrologic data will, along with rock measurement enable the construction of profiles of rocks and minerals within the magnetic layers and especially the variation of magnetization with depth Rocks characteristic of various tectonic settings will be analyzed to ascertain relationship between tectonics mineralization and magnetization This RTOP supports the following major program element Earth composition This in turn supports the following end ojective of mineral resources assessment

W81-70431 **677-45-04**
Goddard Space Flight Center Greenbelt Md
MAGSAT CORRELATIVE STUDIES
R A Langel 301-344-6565
(677-45-01 677-45-03 677-45-05)

The objectives of the RTOP are to select Magsat data appropriate for crustal anomaly studies suitably process that data and derive a global magnetic anomaly map This RTOP will be accomplished by (1) selecting data from magnetically quiet periods (2) removing the core field as represented by a spherical harmonic expansion (3) removing the best available approximation of external field and (4) deriving 2 deg x 2 deg average residual fields and plot the results This RTOP supports the Non-Renewable Resources Program which in turn supports the end objectives of resource assessment

W81-70432 **677-47-01**
Jet Propulsion Laboratory Pasadena Calif
AIRCRAFT THERMAL INFRARED SCANNER
Alexander F H Goetz 213-354-3833
(677-41-02 677-41-03)

The purpose of this task is to design and construct a 6-channel aircraft multispectral scanner to span the wavelength region 8 to 13 micrometers The scanner will cover the bands 8 3 to 8 8 8 8 to 9 3 9 3 to 9 8 10 1 to 11 0 11 0 to 12 0 12 0 to 13 0 micrometers with an NE delta T of 0 5 K at 300 K target brightness temperature Remote sensing to the present time has focused on identification and discrimination of rocks using visible and near infrared reflectance measurements This region tends to be dominated by presence and oxidation state of iron and by water in hydrous silicates principally clays The so-called emission region (8 to 14 micrometers principally) contains an abundance of spectral bands arising from fundamental Si-O vibrations with detailed band position depending upon Si-O polymerization in silicate minerals The diagnostic information available has as yet been utilized sparingly primarily because of the lack of instrumentation The Thermal Infrared Multispectral Scanner (TIMS) will be built using existing technology and based on the Daedalus DS-1260 and DS-1280 scanners Items requiring new development are the scan head reference sources and 6-channel spectrometer The design material is subject to NASA approval Test areas will be chosen for which extensive ground based and SMIRR data exist

W81-70433 **677-47-02**
Lyndon B Johnson Space Center Houston Tex
EXTENDED SCENE RADAR CALIBRATION
R G Fenner 713-483-3073

The purpose of this RTOP is to establish a method to verify the precision and accuracy of scatterometers and imaging radars used for remote sensing on JSC aircraft The precision and accuracy of microwave remote sensors must be established and verified before there can be meaningful results in investigations such as soil moisture where quantitative traceable measurements of radar backscatter are required The hardware software and measurement techniques for performing this RTOP were developed in FY-78 The FY-79 and FY-80 effort consisted of a comprehensive test series utilizing the 13 3 GHz 4 75 GHz 1 6 GHz and 400 MHz aircraft scatterometers Correlating ground measurements were taken at 13 3 GHz 4 75 GHz and 1 6 GHz Airborne scatterometer data bases were gathered at Northrup Strip White Sands Missile Range Jornada Experimental Range NM and Death Valley CA In addition during FY-79 data was gathered at Jornada Experimental Range for study of row effects on radar backscatter The FY-81 activity will consist of futher detailed studies of extended homogeneous roughness scenes Analysis of FY-79 and FY-80 data have shown that the smoother areas of Northrup Strip and Death Valley have too much subsurface moisture to appear homogeneous to microwaves Test plots with increasing values of random roughness will be measured with ground and airborne scatterometers This data will be evaluated for precision and accuracy Efforts will be made to eliminate subsurface moisture effects by site selection and/or time of measurement

W81-70434 **677-47-03**
Jet Propulsion Laboratory Pasadena Calif
NASA AIRBORNE IMAGING RADAR FACILITY
E R Caro 213-354-3096

The work described in this RTOP provides for the continuing operation and maintenance of an existing airborne synthetic aperture radar (SAR) and the incorporation of specific modifications to the equipment in support of scientific investigations being performed under RTOP 677-41-04 Modifications planned for FY-81 are (1) simultaneous dual polarization operation and (2) digital data recording of radar data The imaging radar facility is available to other NASA funded investigators as a research tool and provides a versatile cost effective means of conducting experiments and acquiring data for demonstration of remote sensing concepts

W81-70435 **677-48-01**
Jet Propulsion Laboratory Pasadena Calif
SEASAT DIGITAL SAR PROCESSING (NON-RENEWABLE RESOURCES)
C F Leang 213-354-3798
(677-37-06)

The objective of this RTOP is to process Seasat radar data to produce synthetic aperture radar images of selected areas in support of Earth resource application studies The processing will be performed using the Interim Digital Processor at JPL Each image will exhibit a 25 meter resolution and cover a 100 Km square target area At least 66 images will be produced in FY-81

W81-70436 **677-76-01**
Jet Propulsion Laboratory Pasadena Calif
SEASAT DIGITAL SAR PROCESSING (RENEWABLE RESOURCES)
C F Leang 213-354-3798
(677-48-01)

The objective of this RTOP is to process Seasat radar data to produce synthetic aperture radar images of selected areas in support of Earth resource application studies The processing will be performed using the Interim Digital Processor at JPL Each image will exhibit a 25 meter resolution and cover a 100 Km square target area At least 50 images will be produced in FY-81

W81-70437 **677-76-04**
National Space Technology Labs Bay Saint Louis Miss
VERY LOW-COST DATA SYSTEM 16-BIT MICROPROCESSOR-DRIVEN ELAS
Ferron Risinger 601-688-3586

The primary objective of this effort is to define assemble and demonstrate a very low-cost data analysis system that is 16 bit microprocessor driven equipped with operating subsystem ELAS and is capable of interactivley processing Landsat MSS data NCIC topt data soils data rainfall data, and thematic mapper simulator data to produce resource menagement information The system will be demonstrated and specifications will be made

available so that anyone in industry can produce a duplicate system A microprocessor driven low cost data analysis system will be designed around a 16 bit INTEL 8086 microprocessor Currently existing operating subsystem ELAS e g miltichannel mulittemporal image analysis software for converting Landsat MSS and supporting auxiliary data to resource management information will be translated to run on the 16 bit INTEL 8086 microprocessor

W81-70438 **677-77-01**
Goddard Space Flight Center Greenbelt Md
MULTISPECTRAL LINEAR ARRAYS FOR THE SHORT-WAVE INFRARED (MLA/SWIR)
Leslie L Thompson 301-344-8107
(677-37-02 677-39-02)

The objective of this RTOP is to design fabricate and demonstrate the required multispectral linear array technology (MLA) for resource observations in the short-wave infrared (SWIR) spectral region and to provide supporting research studies related to remote sensing in the visible near infrared the SWIR especially in the area of calibration In order to develop the SWIR array major contracts will be awarded to private industry Development to proof-of-concept (Phase 1) will be pursued by two contractors with one contractor selected to develop a prototype array of nominally 500 to 1000 elements in a Phase 2 effort Supporting studies will be accomplished inhouse to assure correct performance specifications are applied to the SWIR array development and to develop appropriate calibration techniques and algorithms This RTOP supports (1) Landsat (2) shuttle payloads and (3) the Operational Land Observing System These in turn support the following objectives agricultural and mineral resources environment and disaster assessment

OFFICE OF SPACE SCIENCE

Planetary Geology

W81-70439 **151-01-60**
Ames Research Center Moffett Field Calif
PLANETOLOGY AEOLIAN PROCESSES ON PLANETS
E F Danielsen 415-965-5527

The objective of this activity is to determine the parameters governing aeolian (wind) processes in various planetary environments by means of wind tunnel simulations laboratory experiments Earth analog studies and analyses of spacecraft data The approach will be to conduct experiments using wind tunnel and other laboratory apparatus to study at various atmospheric pressures and compositions (1) conditions for the initiation and sustainment of particle movement (2) model studies of erosion and deposition around various landforms (3) rates of erosion of various natural materials and (4) study by scanning electron microscopy of surface textures produced by wind abrasion under planetary conditions Field experiments will be conducted to determine threshold conditions under natural conditions and to determine aeolian patterns around full-scale landforms and the use of a field portable wind machine for studying the dynamics of dune migration Long term field experiments will continue on the rate of aeolian erosion under natural conditions to provide a check for the laboratory experiments Spacecraft data will be analyzed to interpret aeolian processes on Mars and Venus

W81-70440 **151-01-70**
Jet Propulsion Laboratory Pasadena Calif
PLANETARY GEOLOGY
R S Saunders 213-354-3815

The proposal for Planetary Geology and Mars Data Analysis studies consist of fifteen tasks to be carried out in FY-81 These tasks are being performed in a variety of disciplines volatile evolution origin of Mars fluvial features planetary photogeology interpretation geomorphology of valley networks on Earth and Mars planetary surface tectonics planetary image facility planetary surface weathering study planetary surfaces physical processes voyager data analysis of surface variations on Io geomorphology of the Galilean Satellites planetary radar interpretation radar determination of Venus spin vector systematic near-Earth asteroid search computerized video telescope detection of near-Earth asteroids siding spring/Palomar faint asteroid survey and asteroid flyby mapping spectrometer study

W81-70441 **151-02-60**
Ames Research Center Moffett Field Calif
THEORETICAL STUDIES OF PLANETARY BODIES
J B Pollack 415-965-5530

The purpose of this research is to obtain a better understanding of selected problems pertaining to planetary surface phenomena the composition structure and evolution of planetary bodies and their satellites and the origin of the solar system by means of theoretical investigations employing the results of spacecraft and ground-based experiments Theoretical knowledge physical insight and mathematical modeling techniques are used together with astronomical and geological data to construct self-consistent mathematical descriptions of planetary processes and structure Analysis and interpretation of the results of these model calculations are applied to such topics as the evolution of Jupiter and wind blown surface features on Mars and climatic change on Mars

Planetary Materials

W81-70442 **152-01-40**
Lyndon B Johnson Space Center Houston Tex
PLANETARY MATERIALS LUNAR SAMPLE ANALYSIS
J W Harris 713-483-3274

Lunar sample analysis is a multidisciplinary effort carried out by individual scientists and teams consisting of three program areas (with the estimated number of grants/contracts to be awarded) (1) mineralogy petrology (14 grants/contracts) (2) geochemistry (19 grants/contracts) and (3) physical properties (7 grants/contracts) The Lunar Sample Analysis Program is a continuing effort aimed at understanding the origin and history of the Moon including its age chemical and mineral composition and physical properties Data obtained provides valuable information on the history of the Sun and baseline data for the Planetary processes that will aid in the planning for future planetary missions

W81-70443 **152-02-40**
Lyndon B Johnson Space Center Houston Tex
PLANETARY MATERIALS LABORATORY AND ANALYTICAL STUDIES
R J Williams 713-483-2781
(152-04-40 153-06-40)

The objective of this research is to produce a quantitative understanding of the chemical and physical properties of planetary materials and of the processes by which these materials have been formed and evolved This quantitative understanding is obtained through analytical studies of lunar samples meteorites cosmic dust and closely related synthetic or terrestrial materials A variety of analytical techniques-X-ray fluorescence instrumental neutron activation solid source and gas mass spectrometry gas chromatography ion and electron microprobe analysis and scanning and transmission electron microscopy-are used as appropriate to quantitatively determine the physical chemical and mineralogical properties of planetary materials Experimentation under controlled shock conditions is used to study the effects of physical processes which may have operated during the formation of planetary materials

W81-70444 **152-04-40**
Lyndon B Johnson Space Center Houston Tex
CURATION OF EXTRATERRESTRIAL SAMPLES
P Butler Jr 713-483-3274

The Lunar Sample Program is supported in this program by providing for maintenance of the sample collection under controlled environmental conditions research on techniques of preparation and preservation of lunar meteoritic and cosmic dust samples documentation of the distribution and use of samples preparation and publication of sample information catalogs containing petrographic inventory and processing data and implementation of the sample control system Operation is carried out by a staff of Civil Service scientists and administrators directing a

laboratory effort undertaken by contractor personnel Most effort is involved in preparation of sample materials for approximately 55 domestic and 20 foreign Principal Investigators in the Lunar Sample Program

W81-70445 **152-05-40**
Lyndon B Johnson Space Center Houston Tex
JSC GENERAL OPERATIONS SUPPORT - PLANETARY MATERIALS
M B Duke 713-483-4464

This plan provides for support by JSC of a general operational nature necessary to the planning and conduct of OSS Planetary Materials Programs The plan provides JSC support services for the annual lunar and planetary science conference and the visiting scientist programs of NASA Support services include transportation logistics publications library audio-visual photographic data processing fabrication and in-house laboratory utilization A certain amount of in-house laboratory operations are dedicated through this plan to general program support such as that provided to pre-proposal definition studies specialized studies for the Sample Curator and mission support activities This plan also supports a continuing study by in-house scientists to define the role of the planetary program This study systematically identifies gaps in current knowledge and defines specific scientific requirements for future space missions

Planetary Geochemistry and Geophysics

W81-70446 **153-01-60**
Ames Research Center Moffett Field Calif
FORMATION, EVOLUTION, AND STABILITY OF PROTO-STELLAR DISKS
P M Cassen 415-965-5597

The objectives of this research are to obtain an understanding of the solar nebula and proto-stellar disks in general by analysis of theoretical models based on hydrodynamic and thermodynamic principles The formation of proto-stellar accretion disks from collapsing gas clouds will be studied and the evolution of their densities and thermodynamic properties will be described Other objectives are to examine by numerical experiments the stability of proto-stellar disks against gravitational condensation and to explore the role of instabilities in planetary formation Results will be analyzed in the light of observations of the solar system and astronomical objects identified as proto-stars

W81-70447 **153-02-40**
Lyndon B Johnson Space Center Houston Tex
EXPERIMENTAL STUDIES
W C Phinney 713-483-3816

The objective of this research is to develop the values of necessary parameters that allow a quantitative understanding of the chemical and physical processes that produce observed planetary materials The development of the necessary data is accomplished by means of experimentation with both natural and synthetic materials under controlled conditions of temperature pressure oxidation-reduction shock and composition Specific mineralogic compositions textural relations and phase assemblages can thus be related to specific sets of chemical and physical conditions that may occur on or within planetary bodies These conditions provide constraints for interpretations of planetary processes

W81-70448 **153-02-70**
Jet Propulsion Laboratory Pasadena Calif
PETROLOGY LAB
Anthony A Finnerty 213-354-4785

This RTOP supports investigations being conducted in planetary petrology through experiments on model compositions terrestrial rocks meteorites and lunar rocks and thermodynamic theory The investigations will interface with ongoing studies in planetology to provide petrological constraints for models of composition petrology and thermal structure of planetary interiors

W81-70449 **153-03-42**
Lyndon B Johnson Space Center Houston Tex
INTERIOR MODELS
W C Phinney 713-483-3816

The objective of this study is to provide further models of planetary scale chemical differentiation outgassing of atmospheres and petrogenesis The study will utilize the temperature and mass transport outputs from global thermal models to determine the effects on partial melting and migration of melts

W81-70450 **153-05-70**
Jet Propulsion Laboratory Pasadena Calif
PLANETARY DYNAMICS
William R Ward 213-354-2594

This program of dynamical investigations is directed at increasing our understanding of solar system formation and evolution Gas-planet gravitational interactions including both secular resonance effects and nebula tides will be studied These studies may furnish much needed boundary conditions for solar system formation models Planetary accretion models will be developed particularly for the outer planets Studies of planetary ring dynamics will continue with possible applications to Saturn s rings Secular resonances as a means of transporting asteroidal material to Earth and Mars crossing orbits will continue to be investigated The effects of Jupiter resonances on the asteroid belt and the Trojans will be examined in more detail Observations to establish rotation rates and accurate orbits of asteroids will be carried out Advanced modeling of the Oort cometary cloud will also be pursued Further studies of the role of tides on Jupiter and Io in maintaining the three-body lock and heating Io will be made The effects of dissipation on lunar physical librations, the generation of planetary wobble resonances and the tidal histories of asteroidal satellites and the Pluto/Satellite system are other theoretical issues that will be examined In addition new observations of Saturn s new satellites are needed to obtain more accurate orbits

W81-70451 **153-06-70**
Jet Propulsion Laboratory Pasadena Calif
PLANETARY SYNTHESIS
Gary A Ransford 213-354-2451

This RTOP consists of eight tasks in the areas of comparative planetology of satellites geochemical mapping surface properties of planetary satellites lunar multispectral imaging Jovian satellite geophysics equipment development for remote sensing experiments and spectrogoniometry

W81-70452 **153-07-40**
Lyndon B Johnson Space Center Houston Tex
REMOTE SENSING
W C Phinney 713-483-3816

The objective of this research is to optimize the ability to interpret and utilize remotely sensed data from planetary surfaces A laboratory program based on infrared interferometry of particulate materials will define the spectral radiative transfer regime in planetary surfaces The results when used with remotely sensed observations will yield data which can be interpreted in terms of the experimental work and which can be compared to results from other techniques A second program will utilize mathematical techniques to improve the spatial resolution of X-ray fluorescence and gamma ray data used for lunar geochemical maps

W81-70453 **153-07-70**
Jet Propulsion Laboratory Pasadena Calif
RADAR STUDIES
Charles Elachi 213-354-5673

The objectives of this RTOP are to (1) develop a data base for the interpretation of radar data of planetary surfaces which will be obtained with an orbiting sensor Specific mission in mind is the VOIR 84 (2) develop the techniques to interpret these data (3) get the planetary sciences community familiar with the interpretation of radar images and (4) develop an Imaging Radar Data Center at JPL in support of the above activities The data base will consist of (1) A/C Seasat-A and SIR-A radar images (2) LANDSAT images (3) geologic maps

and (4) ground images These data will be obtained for a wide variety of representative test sites

W81-70454 **153-08-50**
Goddard Space Flight Center Greenbelt Md
EXPERIMENTAL MAGNETISM
Peter Wasilewski 301-344-8317

An experimental magnetism program is conducted to develop a basis for the understanding of shock induced magnetization in FeNi alloys to calibrate the FeNi system to refine model system calibrations, and to develop metallographic magnetic criteria in order to provide a fundamental basis for analysis of the magnetic record in extraterrestrial materials This information is to be used in evaluating both laboratory developed magnetic records in natural and synthetic samples and the magnetic record in specific natural samples as a test of the effectiveness of the program Utilizing the light gaS gun at the Goddard Space Flight Center specimens of Copper-Iron alloy which contain fcc iron spheres will be impacted to transform the nonmagnetic fcc iron to magnetic bcc iron These specimens will be used to characterize the magnetic effects associated with a first order fcc to bcc magnetic transformation The discs will be remachined and reimpacted to characterize the magnetic effects due to impacting a fine particle bcc iron In addition thermal demagnetization of both NRM states will be evaluated and the effects of recrystallization investigated Iron Nickel alloys will be subjected to varying shock levels after being prepared via different thermal histories

W81-70455 **153-08-60**
Ames Research Center Moffett Field Calif
NASA AMES RESEARCH CENTER VERTICAL GUN FACILITY
O L Koontz 415-965-5526

The Ames Research Center Vertical Gun Range is a ballistic facility used to simulate and study the physics and mechanics of planetary impact cratering phenomenon Ballistic technologies utilizing light gas gun powder enable acceleration of projectiles up to 2 centimeters diameter at relative velocities of approximately 8 km/sec By varying the gun s angle of elevation with respect to the target vacuum tank impact angles from 0 deg to 90 deg with respect to the gravitational vector are possible In conjunction with the Lunar and Planetary Institute Ames Research Center will operate the Ames Vertical Gun Facility as a national facility manage its operations including manpower expendables and targets maintain equipment and provide for facility modification and upgrading as needed Ames Research Center proposes to operate the facility in such a manner as to provide maximum support to the scientific community in the studying and understanding of impact processes in planetary formation and modification

W81-70456 **153-10-40**
Lyndon B Johnson Space Center Houston Tex
JSC GENERAL OPERATIONS - GEOPHYSICS AND GEOCHEMISTRY
M B Duke 713-483-4464

General operations support a variety of institutional and scientific support tasks at JSC that are considered essential for the conduct of research and for implementation of the Planetary Geophysics and Geochemistry Program Center support services such as printing computer photographic and graphics are provided through a procedural agreement with the Lunar and Planetary Institute In-house support provides for co-sponsorship of conferences laboratory costs required by visiting scientists using existing facilities, and for costs required to operate common laboratory facilities and to provide for support services from other Center elements

Planetary Atmospheres

W81-70457 **154-10-80**
Ames Research Center Moffett Field Calif
PLANETARY ATMOSPHERIC COMPOSITION AND STRUCTURE
J B Pollack 415-965-5530

Theoretical modeling and spacecraft data interpretation are used to determine the properties and physical processes characteristic of planetary atmospheres These properties include their temperature structure aerosols cloud layers gaseous constituents and opacity sources Emphasis is placed on reducing and analyzing data returned from spacecraft missions such as Pioneer Venus or preparing for data expected from future spacecraft missions such as Voyager However use is also made of relevant ground-based observations Tasks relevant to Pioneer Venus include data analysis of results from the large probe infrared radiometer atmospheric structure and gas chromatography experiments Other tasks are directed at investigating the properties of Titan s atmosphere and the rings of Saturn Such investigations are relevant for both the upcoming Voyager mission through the Saturn system and the contemplated SOP2 mission

W81-70458 **154-10-80**
Jet Propulsion Laboratory Pasadena Calif
PLANETARY ATMOSPHERES COMPOSITION AND STRUCTURE
J T Bergstralh 213-354-2517

The Pioneer Data Analysis subtask covers an analysis of Jovian photopolarimetric (IPP) and radiometric (IRR) data from Pioneer 10 and 11 spacecraft The approach is to use the spacecraft data in conjunction with selected ground-based observations made near the times of the spacecraft encounters to constrain realistic models of Jupiter s lower stratosphere and upper troposphere This includes temperature and cloud profiles for major regions of the planet for which adequate geometric control has been established The work is divided into three distinct parts (1) qualitative comparison of Jovian images at visible and thermal infrared wavelengths (2) quantitative analysis of Jovian thermal infrared data to derive temperature structure and some cloud properties and (3) quantitative analysis of Jovian reflectivity data to derive cloud distribution and microphysical properties The Outer-Planet Equilibrium Models subtask continues the development of detailed model atmosphere algorithms applicable to the tropospheres and stratospheres of the outer planets A computer code which predicts infrared flux divergence pressure-temperature profiles and the corresponding thermal emission spectra is now operating At present our approach is based on standard assumptions of radiative convective and local-thermodynamic-equilibrium states The calculational procedure involves a combination of analytic approximations and straightforward numerical techniques in the context of a radiative flux divergence formulation All aspects of the calculations including the method must be examined and evaluated Survey models have been generated for atmospheres composed of H2 He CH4 C2H6 and C2H2 and incorporating a relatively crude treatment of aerosol heating Nonuniform aerosol distributions exhibit striking effects particularly in the stratospheres effects which point dramatically to the need for improvements and refinements in the treatment of aerosol heating (as part of this ongoing task)

W81-70459 **154-20-80**
Goddard Space Flight Center Greenbelt Md
PLANETARY ATMOSPHERIC DYNAMICS
J A Pirraglia 301-344-6783

Planetary missions supplemented by ground based and airborne instruments have greatly increased our knowledge of the atmospheres of Venus Mars Jupiter Saturn and their satellites The planets and their satellites present contrasts in mass rotation rates radiative time constants heat deposition and topographic influence of the atmosphere and for a better understanding of these disparate atmospheres it is necessary to develop a general approach to theoretical atmospheric dynamics

based upon the existing data obtained from the planetary missions The widely differing conditions permit the isolation of specific phenomena and allow comparisons of different regions of the parameter space associated with a particular phenomenon Atmospheric circulation is strongly affected by energy and momentum transport The relationship between the mean flow and the waves that contribute to the transport processes will be investigated through a study of forced waves and wave instabilities in an inhomogeneous mean flow and by a study of the influence of the higher order interaction terms on the mean flow The transport or interaction models will be applied to the various planets which have different ranges of parameters to assess the models under a wide set of conditions

W81-70460 **154-20-80**
Ames Research Center Moffett Field Calif
DYNAMICS OF PLANETARY ATMOSPHERES
R E Young 415-965-5515

The dynamics of the atmosphere of Venus is being studied using a 3-dimensional circulation model The fully coupled nonlinear momentum and energy equations are solved numerically using a combination of finite differences and spectral methods The principal goals are to understand the dynamical effects of varying planetary rotation rate solar energy deposition infrared opacity atmospheric mass and composition

W81-70461 **154-20-80**
Jet Propulsion Laboratory Pasadena Calif
DYNAMIC RADIATIVE INTERACTION
R W Zurek 213-354-3725

Dynamic-radiative interaction will be studied to understand the spectacular planetary-scale evolution of Martian great dust storms by simulating the basic interaction between dynamic and radiatively active airborne dust which occurs in a dusty atmosphere Atmospheric dynamical models will be developed to understand major dynamical processes of the Venus atmospheric circulations These include the solar related (tidal) component large-scale instability mechanisms and the thermospheric circulation The thermospheres of Mars and Io will also be modeled to determine their basic dynamical characteristics The radio scattering effects observed during the radio occultation measurements of various planetary missions will be analyzed to develop algorithms needed to study (1) turbulence in planetary atmospheres (2) electron density irregularities in planetary ionospheres and (3) the magnetic field in planetary and satellite ionospheres Time-lapse Jupiter data products will be analyzed to complete assembly of a representative subset of the Voyager Jupiter photographs into time lapse motion pictures which will clearly and accurately portray the visible activity of features in the Jovian atmosphere over two periods of several weeks each These 16mm motion pictures showing constant regions of the planet on successive rotations and digital records of the map projected data sets will be delivered to the National Space Science Data Center (NSSDC) in forms which can readily and economically be accessed by any investigator engaged in meteorological research

W81-70462 **154-30-80**
Ames Research Center Moffett Field Calif
PLANETARY CLOUDS, PARTICULATES, AND ICES CLOUDS OF VENUS
R C Whitten 415-965-5498
(154-75-80 147-30-02 154-10-80)

A model of the Venus clouds which simulates gas phase sulfur chemistry and the height and size distribution of the cloud particles has been constructed The model will be used to search for important but still unrecognized processes associated with the clouds and for possible errors in interpretation of cloud observations A series of models are being used to evaluate the interactions between dynamics radiation electric fields and clouds The cloud model will be used to look for processes which might cause precipitation and electric charging A radiative model is used to clarify the relative importance of cloud and gas opacity to the unstable region at the cloud base and a simple dynamic model is used to assess the magnitude of cloud-radiation-dynamics interactions Observational data on the Venus cloud layer obtained by Pioneer Venus probe instruments have led to detailed knowledge of cloud structure The data will continue to be analyzed and interpreted in terms of particle size distribution height distribution and composition

W81-70463 **154-30-80**
Jet Propulsion Laboratory Pasadena Calif
CLOUDS, PARTICULATES AND ICES
M S Hanner 213-354-4100

This RTOP covers 3 activities (1) Venus cloud properties (2) infrared emission of cometary dust and (3) Jovian cloud properties The objective of the Venus cloud study is to understand the condensation properties of the clouds their liquid content, growth of cloud droplets possibility of precipitation, and Venusian lightning Mariner 10 and Pioneer Venus radio occultation data and probe data are used to derive the liquid content of the clouds Effects of lightning on the chemical properties of sulfuric acid-water clouds will be studied experimentally The objective of the cometary dust study is to compute the thermal emission of cometary dust grains as a function of particle size wavelength and heliocentric distance based on measured refractive indices for ice silicates and absorbing materials These models are compared with observations of infrared cometary emission, in order to derive the composition and dominant size range of the dust being emitted from specific comets and are applied to predicting dust emission characteristics for potential target comets of a cometary mission The objective of the Jupiter cloud study is to use Voyager Imaging and IRIS data combined with high resolution ground based 5 micrometer images to determine physical parameters for the Jovian and eventually Saturnian clouds as follows (1) catagorize Jovian cloud images in terms of gross morphology and possible terrestrial analogs (2) use Voyager data to map cloud stratigraphy (3) use imaging and 5 micrometer data to determine the vertical wind shear in the Equatorial Zone (EZ) (4) combine Voyager imaging IRIS and 5 micrometer mapping to constrain chromophore models for the coloring agents of the Jovian clouds (5) use IRIS imaging and 5 micrometer data to measure the upper atmosphere temperature structure in relation to the lower cloud opacities and (6) combine dynamical data with morphology and stratigraphy to characterize fully regimes of activity in the Jovian atmosphere

W81-70464 **154-40-80**
Jet Propulsion Laboratory Pasadena Calif
RADIATIVE TRANSFER IN CLOUDY ATMOSPHERE
M Chahine 213-354-2433

The objective of this research is the development and application of numerical techniques for the interpretation of remote sensing data obtained under realistic cloudy and hazy conditions Specifically studies will be conducted to (1) develop an analytical approach for uncoupling the thermal emission of the clear and cloudy portions of the field of view of an observing system including the case of haze layer overlying the clouds (2) develop and apply numerical method for the determination of the radiative transfer properties of clouds for Venus Jupiter and Saturn and of rings for Jupiter and Saturn (3) formulate an approach for the determination of gaseous mixing ratios gases to cloud particles mixing ratios and composition profiles from measurements obtained in the presence of clouds (4) apply these results to the study of information content of multiple scattering from model Jupiter and Saturn cloud and ring particles and (5) apply these results to the analysis of the Jovian thermal sounding problem By treating the cloud and haze effects on the clear-column radiance as short term oscillations it is possible to uncouple the radiative effects of clouds and hazes from the radiative effects of gaseous absorbers Once the clear-column temperature profiles are determined the same radiance data could then be used to determine the heights amounts, and radiative transfer properties of clouds and hazes

W81-70465 **154-50-80**
Goddard Space Flight Center Greenbelt Md
ATOMIC AND MOLECULAR PROPERTIES OF PLANETARY ATMOSPHERIC CONSTITUENTS
P E Jennings 301-344-7538
(196-41-54 198-10-01 188-41-55)

The principal goal of this molecular spectroscopy program is to develop an organized solid body of knowledge of the molecular properties of planetary atmospheric constituents The objectives leading to the overall goal of this program as well as the approaches to be taken center around the need for ultrahigh resolution laboratory spectroscopy Accurate interpretation of infrared molecular spectra of planetary atmospheres requires prior analysis of laboratory data of the highest possible spectral resolution Single features apparent in medium or high resolution Fourier transform spectra are often composed of more than one molecular transition and the parameters (1) frequency (2) strength (3) lower state energy and (4) foreign-broadening must be known for each as input in derivations of thermal and chemical properties of the atmosphere For infrared heterodyne observations the need for ultra-high resolution laboratory data is especially critical since the bandwidths accessible to these receivers are narrow and Doppler line profiles are completely resolved in the observed spectra Conventional grating or FTS laboratory spectra are not capable of the required Doppler-limited resolution except in the near infrared

W81-70466 **154-50-80**
Jet Propulsion Laboratory Pasadena Calif
ATOMIC AND MOLECULAR PROPERTIES
M Geller 213-354-2593

A broad program of theoretical and experimental studies pertaining to planetary atmospheres will be conducted with the following primary objectives (1) to understand the properties and determine the parameters of the constituents of planetary atmospheres (2) to apply experimental data (laboratory astronomical and spacecraft) to the understanding and interpretation of spectral features of complex planetary atmospheres and (3) to apply these findings toward the design of ground based and spacecarft experimental concepts The studies to be conducted in FY 81 pertain to the determination of millimeter and submillimeter spectra theoretical spectroscopic development and continuation of collaborative effort with Dr G Birnbaum of the National Bureau of Standards on long path multithermal measurements of the opacity of major constituents of planetary atmospheres in the far infrared

W81-70467 **154-60-80**
Goddard Space Flight Center Greenbelt Md
PLANETARY AERONOMY THEORY AND ANALYSIS
R E Hartle 301-344-8234

The basic objective is to study the observed properties of the neutral atmospheres and ionospheres of the planets and their satellites, including earth in order to identify and interpret the physical and chemical processes governing their behavior encompassing solar planetary relationships The motivating philosophy here is that the study of processes occurring in the atmospheres and ionospheres of the planets and their satellites provides important insights into the nature of similar processes operative in the earth s atmosphere and ionosphere under different parametric conditions and vice versa These investigations are pursued by analyzing and interpreting experimental data derived largely from flight programs after funding from project offices has terminated The data is used to determine the various chemical, compositional dynamical and energetic states of the respective atmospheres and ionospheres, including the transport and deposition of mass, momentum and energy in these regimes In general, the approach involves the development of empirical descriptions of either global or small scale phenomena using data sets from a variety of spacecraft These empirical descriptions of the atmospheres and ionospheres are subsequently interpreted using theoretical models developed to deduce the physical and chemical processes involved Some of the specific phenomena addressed in this investigation include atmospheric and ionospheric motions in Venus and earth interaction of solar wind and/or magnetosphere with atmosphere of Venus and earth including modification of transport coefficients by plasma instabilities solar planetary relationships comparative planetary atmospheres etc

W81-70468 **154-60-80**
Jet Propulsion Laboratory Pasadena Calif
AERONOMY THEORY AND ANALYSIS
Wesley T Huntress 213-354-2140
(154-75-80)

In this fiscal year, there is one small task in this RTOP at JPL to continue the work done last year in developing a comprehensive 1D model of the chemistry in cometary comae The objective is to identify the major photochemical and ionic processes occurring in cometary comae by comparing observations of the column densities of key constituents observed in comet spectra with column densities predicted by models with differing initial parent composition The work is closely allied to laboratory work being conducted on ion molecule reactions in comets

W81-70469 **154-70-80**
Goddard Space Flight Center Greenbelt Md
ULTRAVIOLET SPECTROSCOPY OF PLANETARY ATOMS AND MOLECULES
L J Stief 301-344-7529

The objectives of this research are to measure the optical properties of atoms free radicals and molecules which are important in understanding the composition of planetary atmospheres and comets Emphasis is placed on those problems which are of immediate concern for interpreting the results of rocket satellite and planetary probe observations Several types of spectroscopic measurements are made First photoabsorption and photoionization cross sections are measured Cross sections are also determined for producing ion or atomic fragments in given excited electronic states Branching ratios are measured for excited states which radiate into lower level excited states via photon emission Electron impact excitation cross sections are determined

W81-70470 **154-70-80**
Jet Propulsion Laboratory Pasadena Calif
AERONOMY ENERGY DEPOSITION
Sandor Trajmar 213-354-2145

Electron impact excitation and ionization of species which are important in planetary environments (with major emphasis on the Jupiter environment) will be studied Cross sections for these processes will be measured The species will include both neutral atoms (Ne Na K S Mg Ca O N Si Fe) and molecules (CO H2O CO2 CH4 NH3 SO2) The measurements will be carried out utilizing spectrometers and techniques developed in our laboratories The results will be made available to researchers involved in planetary observations and modeling Efforts will be made to correlate the laboratory work with modeling needs as they develop and to help the interpretation of optical observations as well as the planning of future observations Electron impact cross sections for elastic and inelastic scattering from positive ions will be measured The ions will include SII SIII OII OIII H2(+) N2(+) and CO(+) and are important components of the Io-Jupiter Torus System (sulfur and oxygen ions) and of cometary ionospheres (N2(+) and CO(+) This laboratory work is correlated with the present and future cross section needs of modelers concerned with electron energy degradation and line radiation in these dilute plasmas An experimental apparatus has been fabricated which can measure the optical emission cross sections produced by electron impact for atoms and molecules of planetary interest especially those found in the Jovian planetary system The proposed laboratory measurements have immediate application to the modeling of Voyager and International Ultraviolet Explorer UV observations of the Jovian planetary system emissions In addition the extensive observations of the Jovian system to be carried out by earth satellites (Copernicus International Ultraviolet Explorer and Large Space Telescope) and by interplanetary spacecraft (Galileo and Solar Polar), need supportive laboratory data on strong emissions for mission planning and data analysis purposes

W81-70471 **154-75-80**
Goddard Space Flight Center Greenbelt Md
COSMIC CHEMISTRY AERONOMY, COMETS, GRAINS
B Donn 301-344-5014

This RTOP studies physiochemical phenomena in planetary atmospheres comets and related aspects of interstellar matter Laser spectroscopy photochemistry reaction kinetics and condensation processes are investigated and properties of atoms radicals molecules and grains are measured These experimental results are used to interpret astronomical observations and develop theoretical models Flash photolysis-resonance fluorescence apparatus with computer interface for real time data analysis yields absolute atom-molecule rate constants A CW tunable dye laser may be used for radical detection A tunable laser is used to detect and study properties of photofragments from planetary or cometary radicals Gas phase condensation is used to simulate primordial solar system cometary or interstellar grains and to study mechanism of production A particle accelerator irradiates ice mixtures to study cosmic ray effects on comets The vaporization process of simulated cometary ice mixtures is investigated with various gas composition analyzers The spectra of comets to mag 15 and beyond are systematically obtained at Mt Lemon Observatory University of Arizona The IUE observatory is used to obtain ultraviolet spectra of comets brighter than about mag 7

W81-70472 **154-75-80**
Ames Research Center Moffett Field Calif
AERONOMY OF PLANETARY ATMOSPHERES CHEMISTRY
R C Whitten 415-965-5498
(154-30-80 198-30-02 154-10-80)

Theoretical modeling is used to determine the chemical properties of the atmospheres of Titan and Mars Estimates of the formation rates and abundances of hydrocarbon-aminos due to charged particle reactions caused by cosmic rays or trapped particles will be made from model studies Model studies of the Martian atmosphere are used to explain the temporal variation of zone and to relate the variations to changes in temperature and atmospheric water vapor Laboratory studies of chemical processes important to the structure of planetary atmospheres are in progress Measurements of the photolysis quantum yield of OCS have been completed and the possibility of photo-oxidation of SO2 in an atmosphere of CO2 is being investigated

W81-70473 **154-75-80**
Jet Propulsion Laboratory Pasadena Calif
AERONOMY CHEMISTRY
Wesley T Huntress 213-354-2140

The objective of this work is to conduct laboratory investigations of the ion chemistry in planetary atmospheres and cometary comae The goal of the ion chemistry work is to obtain product distributions and rate constants for ion-molecule reactions important in the atmospheres of Venus Io the outer planets and in cometary comae The major emphasis in this fiscal year will be on comets A photochemistry study will elucidate the chemistry of the Venus atmosphere in the 60 to 90 km region The roles of SO2 and HCl in the Venus atmosphere will be studied with the particular objectives of explaining the photochemical stability of CO2 and the detailed sulfur chemistry leading to cloud formation Support will be provided to NASA Headquarters in the area of laboratory studies and a detailee to NASA Headquarters will support a survey of the planetary atmospheres program work in instrument development

W81-70474 **154-80-80**
Goddard Space Flight Center Greenbelt Md
EXTENDED ATMOSPHERES
H A Taylor 301-344-6610

The objective of the RTOP is to advance the understanding of solar-planetary relationships using the evidence of the global characteristics of ionosphereneutral atmosphere variations as indicators of coupling processes regulating the upper atmosphere in the region extending from the exobase to the ionopause By examining the behavior of the ionic constituents at lower altitudes near the exobase and at higher altitudes approaching the ionopause insight is obtained with respect to collision dominated as well as collisionless processes Such studies relate to longer term effects such as the basic planetary atmosphere evolution as well as short term effects such as the ionospheric response to solar wind variability The approach involves the examination and description of global data sets of satellite and ground-based data relevant to the composition structure and energetic states of the planetary atmosphereionosphere system These descriptions include large scale results in the form of empirical models as well as phenomenological data sets descriptive of uniquely varying conditions or events Results of the empirical studies are assessed in terms of current theoretical models Comparison of model results for contrasting planetary conditions e g Earth and Venus provides a basis for testing basic physical concepts

W81-70475 **154-80-80**
Jet Propulsion Laboratory Pasadena Calif
EXTENDED ATMOSPHERES
R S Wolff 213-354-5073

This RTOP is for modelling of the extended atmospheres of Europa Ganymede and Callisto and their interactions with the Jovian magnetosphere The overall objective of the proposed research is to construct a variety of possible models of the magnetospheres of Europa Ganymede and Callisto and to study the interaction of each of these systems with a Jovian magnetosphere From these models we should then be able to construct a set of observable criteria which would serve as unique signatures for each of the various models Specifically we will continue construction begun in FY-80 of numerical and analytic models of magnetohydrodynamic (MHD) flow past each of the three satellites as a function of surface conductivity and the intrinsic magnetic fields of the satellites Models will also be developed of each of the satellite atmospheres based on existing Voyager and ground based observations To model the MHD flow past the satellites we have constructed a two dimensional Eulerian hydrodynamic code based on the Flux-Corrected-Transport (FCT) algorithm of J Boris and D Book of NRL This code is able to handle both subsonic and supersonic flows During FY-81 magnetic fields will be incorporated into the code and experimentation on magnetized flow past conducting spheres will be initiated We shall also calculate the effect that any extant atmospheres of the satellites would have on the flow In particular efforts begun in FY-80 to determine whether or not the atmospheres of the satellites present any obstacle to the flow will continue in FY-81 Cometary-like models of satellite atmospheres and ionospheres will be constructed assuming icy surfaces for all three satellites Although water ice is most likely the dominant volatile other ices will also be considered If a satellite s atmosphere is unable to stand off the Jovian plasma then unless a sufficiently strong intrinsic magnetic field exists the (corotating) plasma must impact the satellite surface directly

W81-70476 **154-90-80**
Jet Propulsion Laboratory Pasadena Calif
ATMOSPHERIC EXPERIMENT DEVELOPMENT
Daniel J McCleese 213-354-2317

The objective of this task is to evolve new or improved infrared instrumentation and analysis techniques for NASA s program of planetary exploration from spacecraft The emphasis is on the following goals (1) profile temperature in outer planet atmospheres (2) identify and map major and minor atmospheric constituents and their variability (3) determine the circulation in regions of planetary atmospheres free of clouds (4) develop and utilize instrumentation to address these goals At JPL we have an experienced infrared experiment group with expertise in detailed atmospheric modelling development of data analysis techniques and laboratory development of critical hardware In a synergistic program of modelling and hardware development experiments are evolved for specific measurement goals In this way improved experiments for the investigation of planetary atmospheres by infrared remote sensing will be availalbe for future missions and earth orbital platforms

W81-70477 **154-90-80**
Goddard Space Flight Center Greenbelt Md
PLANETARY ATMOSPHERE EXPERIMENT DEVELOPMENT
H B Niemann 301-344-8706

The objective of this work is to develop instrumentation and necessary specialized test and calibration techniques for in-situ neutral gas and ion composition and density measurements in

planetary atmospheres The instrument development is focussed on neutral gas and ion mass spectrometry Different atmospheric environments encountered in various planetary missions as well as the different scientific goals set for the studies of the planets require instrument performances which are highly mission specific Work will be done in five areas The first is mass spectrometer sensor development Ion source efficiencies will be optimized for operation in high particle velocity regimes (or = 50km/sec) High pressure ion source and large dynamic range analyzer systems will be developed for trace gas detection The second area is sample inlet systems Compact gas leaks for pressure reduction from high pressure atmospheres to ion source operating levels and sample enrichment techniques for trace gas analysis will be developed The third area is calibration and test equipment Intermediate velocity molecular and atomic beam systems and trace gas mixing systems will be developed to simulate expected planetary and cometary atmosphere conditions for evaluation of instrument performance and calibration The fourth area is electronics systems Advanced digital logic and analog control circuits for onboard data processing using micro processor and hybrid electronics packaging techniques will be developed The fifth area is auxiliary systems Light weight vacuum pumps for application in high pressure atmosphere on planetary entry probes will be developed

Mars Data Analysis

W81-70478 **155-04-80**
Goddard Space Flight Center Greenbelt, Md
MARS DATA ANALYSIS
B J Conrath 301-344-6088

The Mariner 9 and Viking missions have provided extensive data sets which are available for the study of the Martian atmosphere Investigations of selected physical processes which may provide new insight into phenomena occurring in the lower terrestrial atmosphere are of particular interest This investigation studies the following dynamical phenomena in the Martian atmosphere waves in the stratosphere dust storms the influence of the Martian atmosphere waves in the stratosphere dust storms the influence of the planetary boundary layer on global tides and local thermally driven circulations associated with topography These phenomena are investigated through a combination of data analysis and theoretical modelling

W81-70479 **155-04-80**
Ames Research Center Moffett Field Calif
PLANETARY ATMOSPHERES DATA ANALYSIS
J B Pollack 415-965-5530
(154-10-80 154-20-80 154-30-80)

The basic objective is to relate spacecraft and ground-based observation of planetary atmospheres models Mariner 9 and Viking data yielded information on the structure meteorology and aerosol content of the Martian atmosphere A Martian atmospheric general circulation model will be utilized to aid in interpretation of data taken during the extended Viking mission and to assess the dynamical effects of suspended dust particles A similar 2-dimensional model will be used for long term studies Viking lander imagery data will be used in conjunction with IRIS and Viking X-ray data to determine distribution particle size optical depth and temporal variation of aerosols

W81-70480 **155-20-40**
Lyndon B Johnson Space Center Houston Tex
MARS DATA ANALYSIS PROGRAM
W C Phinney 713-483-3816

The objective of these studies is to provide data on the physical and chemical processes which could have produced rocks and soil on Mars These data should provide a basis for interpretation of the existing remote chemical physical and geological data from Mars particularly those provided by the Viking Mission The studies will use a variety of theoretical experimental analytical and analog to obtain these data The approach will be to use the technique of experimental and theoretical petrology to provide data on melting relations and petrogenesis to use geochemical modelling techniques to constrain the evolution of rock and soil systems to use experimental simulations to quantify the effects of weathering the properties of rocks soils and minerals and to use terrestrial analogs of Martian surface structures to help constrain evolutionary models of Mars crust A wide range of analytical techniques will be used to characterize the physical and chemical properties of materials

W81-70481 **155-20-70**
Jet Propulsion Laboratory Pasadena Calif
MARS DATA ANALYSIS STUDIES
Bruce G Bills 213-354-4159

This RTOP includes JPL Mars data analysis tasks in the geophysics and geochemistry program Tasks are being performed in a variety of disciplines including studies of topography gravity and internal structure atmospheric adsorption into the regolith and photometric and thermophysical properties of the surface of Mars as well as geodetic and dynamical studies of the satellites

W81-70482 **155-41-80**
Jet Propulsion Laboratory Pasadena Calif
MARS DATA ANALYSIS - ASTRONOMY
Robert A Preston 213-354-6895

Radio tracking of the Viking Mars mission orbiters and landers have provided a wealth of radio science data Much of this data remains to be analyzed Viking Lander radio data continues to be transmitted and provides an opportunity for additional scientific return This RTOP will (1) continue the acquistion of Lander Doppler and range data in support of radio science investigation both here at JPL and elsewhere (2) utilize Lander data to improve the orbits of Mars and the Earth determine Mars spin and precession (including seasonal effects) estimate the masses of several asteroids and limit a possible time variation in G (3) process Lander radio observations concurrent with observations of background extragalactic radio sources (Differential Very Long Baseline Interferometry (Delta VLBI) to provide precise angular measurements of Mars s position with respect to a nearly inertial dynamical reference frame for use in solar system dynamical studies and (4) analyze orbiter radio signals to study the solar corona and solar wind

W81-70483 **155-50-01**
Lyndon B Johnson Space Center Houston Tex
MARS DATA ANALYSIS PROGRAM GEOLOGY
W C Phinney 713-483-3816

The broad objective of the study of planetary surface processes is to develop a coherent body of data on planetary surface processes which can be used to design planetary missions and to interpret data as well as boundary conditions on planetary evolution The study of appropriate analogs not only places boundary conditions on the evolution of Mars but also permits on Earth the evaluation of the characteristics of Martian surface instrumentation Future exploration of Mars and other planets includes surface analysis and sample return missions The development of these missions requires suitable instrumentation for analyses on the surface of Mars and analogs of Martian surface material Specific objectives are to characterize the gases released by thermal decomposition of Martian surface analog materials and evaluate the feasibility of accomplishing such analyses in situ and to simulate the mechanical chemical and radiative weathering environments on Mars and study in detail *the resulting products of materials subjected to such conditions*

W81-70484 **155-50-01**
Goddard Space Flight Center Greenbelt Md
DATA REPRODUCTION IN SUPPORT OF THE MARS DATA ANALYSIS PROGRAM
James I Vette 301-344-7354
(404-03-01)

The NASA Headquarters Planetary Division has approximately 110 Principal Investigators Many of these in addition to a number of other planetary scientists will be participating in the Mars Data Analysis Program Many of these investigators require large quantities of data especially photographic products to achieve

the objectives of their investigations Such products are only generally available through the National Space Science Data Center (NSSDC) While the size of these NASA-supported requests would normally result in NSSDC s having to charge for services such funds from university and other nongovernmental investigators would go to the U S Treasury Therefore these funds would not allow NSSDC to purchase the required photographic supplies or pay contractor labor On the other hand the existing budget would not allow NSSDC to supply these investigators with required data and carry out its normal request activity For example NSSDC has received approximately 45 000 feet of 5-inch film containing Viking images A number of investigators will require a complete set of prints and negatives These additional requests cannot be satisfied within the existing NSSDC budget

W81-70485 **155-50-01**
Jet Propulsion Laboratory Pasadena Calif
MDAP GEOLOGY
David E Thompson 213-354-6129

This RTOP supports two general aspects of Mars data analysis First analog studies are carried out to understand processes and physical interactions occurring in the Martian surface environment These tasks are theoretical experimental and field analog in nature Theoretical and experimental work is being carried out in the thermophysical and geochemical properties of Martian soil models This information reconfirms or enhances our understanding and interpretation of Viking and Mariner radiometric observations In addition theoretical and field analog studies are being conducted on the geomorphic processes which shape the Martian outflow channels and the sediment transport relations operative in major catastrophic flooding events akin to those believed to have occurred on Mars An examination of time dependent spatial behavior of albedo and thermal properties of the Mars south polar cap is being carried out by organizing ITM data into motion picture format to discover and monitor time dependent properties All of this work is ultimately constrained and tied back to relevant Viking data both from landers and orbiters The second aspect of this RTOP then is an effort to analyze the reliability of that data and to monitor changes at the lander sites In particular analysis includes estimated of spectral reflectance as distinguishable from datanoise and a major effort to identify and correct orbiter imaging errors to require and document imaging data and to maximize data-search techniques to make an accurate data base availalbe to the scientific community

Instrument Development

W81-70486 **157-01-01**
Jet Propulsion Laboratory Pasadena Calif
ADVANCED CCD CAMERA DEVELOPMENT
J R Janesick 213-354-7734

Previous work on visual Change Coupled Devces (CCD) development has led to the current activity to provide 800x800 element devices for several space flight imaging programs These devices look like they will perform well but have several limitations that currently restrict their use A new device technology has been developed recently that presents an opportunity to overcome some of the most significant limitations of the current 800x800 CCD and at the same time allow the development of even larger array devices This single phase CCD approach has already been demonstrated and is currently ready for development as a scientific sensor The activity to develop the chip is being supported by the Office of Aeronautics and Space Technology (OAST) However, to both eveluate the device and develop the *supporting electronics expertise required in advance of flight* mission use a camera development activity is needed This camera development will happen in conjunction with the device development and will provide the initial electronics design the camera testing and the camera/CCD characterization needed for both effective chip development and future imaging mission support The need for large area device CCD s cameras continues to grow and the performance and producability of the current devices is limited This camera development will open up availability to a much larger community and provide a larger area device

W81-70487 **157-03-01**
Jet Propulsion Laboratory Pasadena Calif
INSTRUMENT DEFINITION
Albert E Metzger 213-354-4017

This RTOP contains the following six tasks (1) definition of the advanced gamma ray spectroscopy (2) alpha/X-Ray analysis using solid state detectors (3) definition of the central cooler for planetary experiments (4) comet thermal modeling (5) laboratory studies of gamma ray and X-Ray remote sensing techniques and (6) construction of an electron microprobe prototype for the analysis of cometary dust The general objective of this program is the timely developement of instruments and techniques to support future missions to solar system bodies

W81-70488 **157-03-40**
Lyndon B Johnson Space Center Houston Tex
INSTRUMENT DEVELOPMENT FOR SPACEFLIGHT EXPERIMENTS
J L Warner 713-483-4464

This RTOP is to initiate detailed development of experiments intended for planetary spacecraft Specifically the Mass Spectrometry-Isotope Dilution (MSID) experiment (L E Hyquist P I) and Particle Imaging and Chemical Analysis (PICA) experiment (E A King Jr P I) are included here Proposals for both instruments were submitted in response to the AO for the International Comet Mission The efforts are for detailed design studies both theoretical and experimental directed at solving problems that must be addressed before the final design effort starts These are studies that must be completed early to assure a proper work flow in designing and fabricating flight hardware The MSID experiment will divide its technical efforts between the mass analyzer and the Sample Processing System (SPS) These efforts will be carried out by both in-house experimental studies and by contracted studies with industry The PICA experiment will divide its technical efforts between the electron optics system and the technology of high voltage on spacecraft These efforts will be carried out by both experimental and theoretical studies at the University of Houston and by contracted studies with industry

W81-70489 **157-03-50**
Goddard Space Flight Center Greenbelt Md
X-RAY, GAMMA-RAY AND NEUTRON GAMMA-RAY METHODS FOR PLANETARY EXPLORATION
J I Trombka 301-344-5941

The objective of this investigation is to develop instrumental systems and obtain cross sections for remote measurements of the spectra X-ray gamma ray and neutron-gamma-ray emission from planetary asteroid and cometary bodies These measurements will be used to obtain geochemical and geophysical information concerning such planetary bodies The X-ray spectrometer study will consider both proportional and solid-state detectors Elemental composition for elements with atomic numbers greater than z = 6 (carbon) using solar X-ray fluorescent spectral measurements are being considered Both theoretical and experimental studies will be used in the investigative program Gamma-ray fluxes produced by electron acceleration by ionosphere-solar wind interactions and by crossing sector boundaries will be calculated The temporal and energy distributions and the flux intensities *will be estimated A major problem in the interpretation of* gamma-ray spectroscopic data with respect to chemical analysis of planetary bodies is the lack of information on cross sections and discrete line gamma-ray emissions from certain key elements (e g C O and H) Both theoretical and experimental studies will be used to obtain this information Furthermore with improved cross sections and spectral data neutron and gamma-ray transport calculations will be carried out to better understand the expected gamma-ray emission from planetary asteroids and cometary surfaces This work would be performed in cooperation with groups at UCSD JPL and LASL

Solar Terrestrial SR&T

W81-70490 **170-36-55**
Marshall Space Flight Center Huntsville Ala
PARTICLE AND PARTICLE FIELD INTERACTIONS
C R Chappell 205-453-3036
(385-36-01)

The objectives of this RTOP are to develop space plasma instrumentation for automated spacecraft sounding rocket and shuttle payloads To accomplish these objectives the following tasks will be performed (1) Complete the development of four Differential Ion Flux Probes (DIFP) to be used for the measurement of multiply-directed low-energy ion streams This technique has been applied in laboratory wind tunnel studies and will be used on two rocket flights into the polar cusp in 1981 (2) Continue the design of a Swept Angle Retarding Ion Mass Spectrometer (SARIMS) for the measurement of low-energy plasma distributions in the ionosphere and magnetosphere This instrument was flown on a mid-latitude sounding rocket in the fall of 1979 and on a high latitude auroral rocket in March 1980 The instrument will be upgraded for potential flight on future NASA and DOD mission (3) Begin development of instrumentation techniques for the measurement of visible UV and near IR emission generated in the aurora and in electron beam experiments

W81-70491 **170-36-55**
Ames Research Center Moffett Field Calif
MAGNETOSPHERIC PHYSICS - PARTICLES AND PARTICLE/FIELD INTERACTION
A Barnes 415-965-5506
(384-47-67 385-36-01)

The objective is to improve understanding of the dynamics origin and termination of the solar wind turbulence in the solar wind and to investigate possible effects of solar and interplanetary phenomena on terrestrial weather and climate Theoretical studies will be conducted aimed at understanding the large-scale dynamics of the solar wind its acceleration and heating mechanisms and waves and turbulence in the solar wind These studies employ known theoretical techniques of plasma physics and magnetohydrodynamics, and also often require extensions of basic theoretical plasma physics Theoretical developments will be related to spacecraft plasma and magnetic data as well as to indirect observations of the solar wind Theoretical studies of possible relations between variations in solar output (radiation and/or charged particles and magnetic fields) and terrestrial weather and climate will be carried out

W81-70492 **170-36-55**
Goddard Space Flight Center Greenbelt Md
PARTICLES AND PARTICLE/FIELD INTERACTIONS
Keith W Ogilvie 301-344-5904

The object of this research is to increase the knowledge and understanding of non thermal plasmas occurring in the interplanetary medium and magnetospheres of planets This requires continuous improvement of measurement techniques concentrating on advanced concepts for plasma detectors magnetometers and radio and plasma wave analyzers Work is also under way to improve the theoretical description of plasma properties, and to improve techniques for the interpretation of the results of appropriate space experiments requiring corresponding improvements in numerical techniques and in methods of data display

W81-70493 **170-36-56**
Goddard Space Flight Center Greenbelt, Md
PARTICLE AND PARTICLE/PHOTON INTERACTIONS (ATMOSPHERIC-MAGNETOSPHERIC COUPLING)
James P Heppner 301-344-8797

The objective is to develop experimental and theoretical approaches for investigating and understanding the processes which provide strong coupling between the neutral atmosphere the collision dominated ionospheric plasma and the collisionless magnetospheric plasma Within the framework of this overall objective, specific sub objectives are identified in terms of having (1) key significance (2) goals which are attainable with limited resources, and (3) close ties to future projects and programs Emphasis is placed on the primary forces electric fields and neutral winds and the associated transport and energization of particles Related topics include electric fields in the earth-ionosphere cavity and their relation to weather processes electric current systems and associated magnetic field disturbances the generation of thermospheric winds and gravity waves atmospheric chemical composition anomalies the transformation of atmospheric ions to trapped radiation auroral particle acceleration mechanisms plasma instabilities producing ionospheric irregularities etc New instrumentation is being designed and developed for observations of tracer chemicals and for measurements of low energy particles Properties of double probes in low density plasma are being studied with the SCATHA satellite Models for the diffusion of tracer particles are to be developed for planning future chemical release experiments The closure of magnetospheric electric fields within the earth-ionosphere cavity is to be studied in support of low and middle atmosphere electric field investigations

W81-70494 **170-36-57**
Goddard Space Flight Center Greenbelt Md
PARTICLE ACCELERATOR FACILITY MAINTENANCE AND OPERATION OF A CALIBRATION FACILITY FOR MAGNETOSPHERIC AND SOLAR-TERRESTRIAL EXPERIMENTS
James H Trainor 301-344-6282

The GSFC Sciences Directorate operates a nuclear particle calibration facility consisting of a 2 MeV Van de Graaf and a 250 keV electrostatic accelerator The facility provides particle energies from 50 eV to 2 MeV and protons via reactions to approximately 20 MeV Particle beams available range from electrons to Kr84 with fluxes from approximately 1 particle/sq cm sec to approximately 10 to the 9th power particle/sq cm sec It has been a unique facility in the world in this low energy region Some of its abilities are now duplicated by an accelerator at MPI Lindau For several years all work in this facility has been in support of magnetospheric and solar-terrestrial research Over the period FY-77 through FY-79 machine time has been split fairly evenly between calibration and testing of satellite experiments testing and development of new particle detector systems and numerous sounding rocket payloads Requests from foreign experimenters amount to 5 to 15% of the machine time The facility operates normally on all working days but the requirements of the experimenters in the past several years have often required operation 6 or 7 days per week and 12-16 hours per day at times That coupled with the declining manpower in Code 660 has forced the facility to rely heavily on contractor manpower for maintenance and operation

W81-70495 **170-38-51**
Marshall Space Flight Center Huntsville Ala
DEVELOPMENT OF EXPERIMENTS AND HARDWARE FOR SOLAR PHYSICS RESEARCH
M J Hagyard 205-453-0118

The objective of this program is to develop an engineering design of a flight experiment to measure very small variations in total solar flux as a new technique for critical study of the dynamics of convection and magnetic fields in the solar convection zone The approach is through development of an instrument a crystal cavity radiometer (CCR) which uses the extreme stability of oscillation of a quartz crystal as a sensitive indicator of changes in solar irradiance

W81-70496 **170-38-51**
Goddard Space Flight Center Greenbelt Md
DEVELOPMENT OF SOLAR SPACELAB EXPERIMENT AND HARDWARE
Robert D Chapman 301-344-5101

The objective is to develop payloads which contribute to the solution of well-defined solar research problems These activities have the ultimate objective of flying payloads on problem-oriented shuttle-Spacelab missions In such missions a payload of instruments is assembled to provide by simultaneous observations of a phenomenon such as solar flare or the outflow of the solar wind at the base of the corona the thorough detail

meeded for a cogent model of that phenomenon As an example of such a mission is SMM for solar flare research This spacecraft will be retrieved by the shuttle and flown again with refurbished instrumentation This and other research problems will form bases for series of missions using the shuttle One of these will be a study of coronal structures contributing to the solar wind and the interplanetary plasma A second will be a study of the sources of high energy particles on the Sun emphasizing instrumentation not accommodated by and/or supplementary to the SMM Instruments Missions emphasizing the phenomenon of coronal heating and mass and energy balance in the chromosphere are also contemplated In each case a number of different instruments covering a wide range of wavelengths is required These will be selected on the basis of making comprehensive measurements in their specific wavelength regions in a format coordinated with and complimentary to the other instruments in the payload For example all instruments will operate with the same temporal and spatial resolution to the maximum possible extent

W81-70497 **170-38-52**
Goddard Space Flight Center Greenbelt Md
GROUND-BASED OBSERVATIONS OF THE SUN
Robert W Hobbs 301-344-7591

The major objective is the measurement of solar radiation at those wavelengths accessible from the ground with resolution (spatial spectral temporal velocity) suitable for supporting investigations of solar phenomena (flares active regions wave motion velocity fields and magnetic fields) carried out in the EUV X-rays and gamma rays by Solar Maximum Mission and other flight missions in the NASA Solar Physics Program and for basic research on the Sun Another objective is the analysis of comet tail photographs to determine the velocity field of the solar wind Several observatory facilities are supported and maintained for this purpose The Laboratory provides support for the Vacuum Tower Telescope at Kitt Peak which specifically provides Hel 10830A spectrohelograms and magnetogram

W81-70498 **170-38-52**
Marshall Space Flight Center Huntsville Ala
GROUND-BASED OBSERVATIONS OF THE SUN
M J Hagyard 205-453-0118
(385-38-01)

The objective of this research is a program of ground-based observations for basic research concerning solar vector magnetic fields and for support of NASA solar missions using the facilities of the MSFC Solar Observatory In the program for basic research a theoretical and observational program will be initiated to study magneto-optical effects in the interpretation of filter vector magnetograph data An upgrading program for the MSFC vector magnetograph system will be undertaken to provide an optimal system for support of NASA solar missions in the mid-80 s and beyond

W81-70499 **170-38-53**
Goddard Space Flight Center Greenbelt Md
EXPERIMENT DEVELOPMENT - LABORATORY AND THEORETICAL SOLAR PHYSICS
Robert D Chapman 301-344-5101

The primary objective is to support the laboratory s on-going programs by developing fundamental experimental and theoretical techniques that are applicable to the analysis of returned data The specific goals are to (1) correctly interpret the nature of observable solar phenomena by understanding fundamental spectroscopic processes and (2) understand these phenomena with regard to the flow of mass energy and momentum from a mechanical energy reservoir such as the convection zone to the chromosphere and corona Major emphasis is given to (1) processes that result in a conversion of mechanical energy associated with photospheric velocity fields into a nonthermal energy flux (e g an acoustic flux Poynting flux etc) (2) processes that result in and control the propagation of this nonthermal energy from its point of generation within the photosphere to the chromosphere and corona (3) processes that result in the irreversible conversion of this energy into thermodynamic end products within the chromosphere and corona (4) processes that control the subsequent dispersal of these thermodynamic end products throughout the chromosphere and corona (e g thermal and nonthermal diffusion) (5) consolidation of the above processes (1)-(4) into models that predict new solar phenomena and explain those already observed With regard to the above the emphasis is given to the identification of spectral lines in high energy spark discharges the calculation of atomic transition probabilities and studies of atomic collision processes in solar plasmas

Advanced Studies

W81-70500 **171-03-00**
Goddard Space Flight Center Greenbelt Md
ORIGINS OF PLASMA IN THE EARTH'S NEIGHBORHOOD (OPEN)
G W Longanecker 301-344-7751

The objective of this RTOP is to develop the scientific and technical basis for a solar terrestrial multi-satellite mission to be proposed for flight in FY-85 to FY-86 The objective of this mission is to provide simultaneous coordinated measurements of the role of plasmas in the transport storage and dissipation of energy in the solar wind and the terrestrial magnetosphere The approach is to conduct preliminary system design studies (feasibility) in the areas of sensors and/or instrument requirements design mission analysis system definition and design and ground data processing systems to meet requirements established by the Solar Terrestrial Program Office and its appointed science working group These studies form the basis for the request for proposal requesting alternate system design concepts from industry as the next step in the OMB Circular A-109 procurement process

Astrophysics SR&T

W81-70501 **188-41-51**
Marshall Space Flight Center Huntsville Ala
UV AND OPTICAL ASTRONOMY
C R ODell 205-453-3033

An observational and interpretaive program of astronomical spectroscopy will be pursued using the Echelle grating nebular spectrograph This will include a program of observations and data interpretation concerning internal velocities in HII regions Identified and candidate optical counterparts to high energy sources will be observed with the objective of providing a more complete understanding of the nature and distribution of the high energy sources Methods of high time resolution photometry spectrophotometry and polarimetry will be applied utilizing among other observational equipment the video detector systems and photon counting equipment The observations will also include selected cataclysmic variables not now known to be X-ray sources A program to observe stars in selected R associations will employ broadband visual and infrared photometry spectroscopy and infrared mapping The facilities at Kitt Peak the University of Wyoming, and other observatories will be utilized

W81-70502 **188-41-51**
Goddard Space Flight Center Greenbelt Md
UV AND OPTICAL ASTRONOMY
A Boggess 301-344-5103

The objective is to pursue a long range program in astronomical research with emphasis on optical observations theoretical astrophysics and other specific topics of special interest to NASA The effort includes operation of ground telescopes, development of new instrumentation for ground and potential space application data interpretation and theoretical studies Spectroscopic and photometric data are obtained from ground telescopes in order to analyze the properties of stellar atmospheres nebulae the interstellar medium, and galaxies Nonequilibrium model atmospheres are being investigated to interpret spectral observations from space and ground observatories Theoretical investigations are carried out in formation and evolution of galaxies and on the evolution of stellar interiors variable stars novae and planetary nebulae

W81-70503 **188-41-51**
Ames Research Center Moffett Field Calif
THEORETICAL STUDIES OF GALAXIES, ACTIVE GALACTIC NUCLEI, AND QUASI STELLAR OBJECTS
L J Caroff 415-965-5536

The objective is to conduct theoretical studies on important

fundamental problems in the formation and evolution of galaxies and in the structure and dynamics of OSOs and active galactic nuclei Much of the effort falls under the aegis of computational astrophysics making use of existing numerical codes for hydrodynamics and radiative transfer as well as developing new ones An important aspect of this area of study is the development of a general method for modeling random phenomena which has wide application to many areas of astrophysics

W81-70504 **188-41-54**
Goddard Space Flight Center Greenbelt Md
FIBER-OPTICALLY MOSAICED LARGE AREA IMAGE SENSORS
Kenneth Hallam 301-344-8701

The objective of this task is to develop and demonstrate the means by which a number N of individual solid-state optical-input mode charge transfer type (CCD CID) image detection devices may be optically-mosaiced to form a single sensor which will detect an image area N-times larger than any single one In many astronomical systems the optical information throughput limit is still set by the detector system rather than by the optical system per se This is especially true where optical scenes carry the required information content to be extracted by image detectors In most cases, the image detector system lacks the analytical capacity to fully utilize the information throughput obtainable with todays optical design and/or technology for telescopes and spectrographs This task is addressed to develop and demonstrate a generally practical and economical means by which existing optical image detectors with limited scene resolvability can be optically combined or mosaiced to detect scenes several times larger than individually possible while preserving or enhancing its other performance characteristics

W81-70505 **188-41-55**
Goddard Space Flight Center Greenbelt Md
INFRARED AND RADIO ASTRONOMY
M J Mumma 301-344-6993

The scientific objective of this program is to provide better understanding of the energetics dynamics compositions excitation conditions and evolution of solar system objects stars proto-stars dust clouds HII regions galactic emissions and extragalactic objects This is achieved by observations of these objects at wavelengths from 1 micron - 10 cm and at spectral resolutions (lambda/delta lambda) from approximately 1 to approximately 1 000 000 Since atmospheric opacity and emissivity prohibit or severely limit ground-based observations at certain wavelengths (4-8 microns and 13-700 microns) high altitude observational platforms such as the C-141 balloons or satellites must be used High sensitivity composite bolometers are being developed in the far infrared to take maximal advantages of low background conditions achievable at these altitudes A balloon-borne 1 2m telescope is being developed to conduct a high sensitivity low spatial resolution multicolor photometric survey of Galactic sources of submillimeter radiation and at least a partial survey of extragalactic sources at these wavelengths Infrared and millimeter/sub-millimeter coherent (heterodyne) spectrometers are developed and used to measure completely resolved intensity profiles for neutral and ionized molecular and atomic lines

W81-70506 **188-41-55**
Ames Research Center Moffett Field Calif
THEORETICAL INFRARED AND RADIO ASTROPHYSICS
D C Black 415-965-5495

The objective of this work is to conduct theoretical studies on fundamental problems in astronomy and astrophysics with emphasis on phenomena susceptible to observational study of infrared and/or radio wavelengths Emphasis will be placed on studies of star formation and on studies of the structure dynamics and evolution of dark molecular clouds There will also be theoretical studies aimed at determining the vibration-rotation line strengths for the ground electronic states of the CO OH and SiO molecules including all of their isotopic variants

W81-70507 **188-41-55**
Jet Propulsion Laboratory Pasadena Calif
RADIO ASTRONOMY
Samuel Gulkis 213-354-5708
(188-41-51 358-78-60 540-01-15)

In the observations task we are continuing a program of ground-based millimeter wave spectroscopy using the new 10-m antennas at the Owens Valley Radio Observatory (OVRO) The 1 7 mm receiver which assembled and operated in 1978 will be employed in observations of SiO H2S and weather permitting HCN We also hope to expand the operating range towards 150 GHz (for H2CO when weather prevents higher frquency operation) and into the 200 to 300 GHz range We plan to continue observations of interstellar molecules with the Kuiper Airborne Observatory (KAO) and of galaxies planetary nebulae and extended HII regions with the Deep Space Network (DSN) The laboratory task will expand a program of millimeter and submillimeter measurements of molecules of astrophysical interest and when the catalogue work indicates a deficiency in the existing data The catalogue of transitions of astrophysical molecules which *now comprises 122 atomic and molecular species has been* released to the community Emphasis is now focussing on the measurement and computation of molecules of high interest for submillimeter astronomy such as CH2 NH2 NH and similar radicals In the Tidbinbilla interferometer task we propose to carry out position measurements on a variety of weak radio sources in the Southern Hemisphere The interferometer utilizes the 34 m and 64 m antennas of the Deep Space Network near Canberra Australia It is the most sensitive interferometer in the southern hemisphere Using this instrument we plan to develop a catalogue of precise positions with an ultimate view to obtaining optical identifications Prerequisite calibration measuremnets and software development have been completed In the K-band Maser task we plan some limited development analysis of the results of the first balloon flight to measure the isotropy of the cosmic background radiation We anticipate additional flights in FY-81 The pulsar rotation constancy task uses DSN stations to monitor a select set of pulsars to measure the rate of spin-down and to document discrete changes in the pulse repetition rate as input to theoretical studies on period instabilities Pulsar timing data are also used to determine precise positions and motions of pulsars

W81-70508 **188-46-56**
Marshall Space Flight Center Huntsville Ala
PARTICLE ASTROPHYSICS
T A Parnell 205-453-5133

The program consists of observations and interpretation of data to determine the origins and source mechanisms of heavy cosmic ray nuclei ($4 < Z$) and cosmic gamma rays between 0 1 and 10 MeV Emphasis is also placed on the improvement of instrumentation and data analysis techniques for further measurements of these particles and for application to Spacelab-era experiments Observations of the nuclei and gamma rays are performed on balloon flights and measurements of detector response are made in the laboratory and at particle accelerators Calculations concerning sources of particles local background and detector response are carried out and verified by measurement

W81-70509 **188-46-56**
Goddard Space Flight Center Greenbelt Md
PARTICLE ASTROPHYSICS AND SHUTTLE EXPERIMENT DEFINITION
F B McDonald 301-344-8801

The objective is to study the properties of the cosmic radiation in order to understand its origin and propagation and to study the properties of the sites in which element synthesis takes place The particles observed are the nuclear and electronic species of the cosmic ray particles Their energy spectra their charge and isotopic composition and their distribution in space Some of these objectives can be met through the imaginative use of short duration observations on balloons Many will require heavier larger-area payloads for which the space shuttle will be an ideal observation platform especially in the sortie mode The details of the chemical composition of the particles as a function of energy is intimately related to the propagation process and must

be completely understood in order to determine the cosmic ray path length distribution and hence, the spatial distribution of cosmic ray sources In addition this will determine the injection spectrum of cosmic ray nuclei The high energy composition measurements are essential in order to determine the source abundances of the rarer cosmic ray nuclei Isotopic composition will enable us to probe the nucleosynthesis going on in the cosmic ray sources The observation of enhanced Ne22, first reported by our group and now being confirmed by others is a prime example of the nonsolar nature of cosmic ray material

W81-70510 **188-46-57**
Goddard Space Flight Center Greenbelt Md
GAMMA RAY ASTRONOMY
C E Fichtel 301-344-6281

The technical objective is to develop the most appropriate detector systems for the observation of the astrophysical sources of very energetic photons The first approach was the development of a large high energy telescope using digitized spark chambers Many major improvements to this basic telescope system are still being pursued and other approaches to detector systems are now being developed for the high energy intermediate energy and low energy gamma ray observations In the medium energy interval (8 to 50 MeV) a second generation experiment is now ready for a balloon flight In the 1/2 to 40 MeV region different detection processes become dominant and hence new detector techniques are required A totally new detector is currently being developed based on the Compton interaction process In the 0 03 to 10 MeV region much of the radiation may consist of monoenergetic line components therefore high resolution spectrometers are also being developed which will be capable of sufficient precision to resolve lines as narrow as may be found in nature In the high energy region improvements in the track imaging chamber systems are continuing and special attention in the track imaging chamber research is now being directed towards drift chambers and larger spark chambers At the same time several approaches are being explored to improve angular resolution including techniques to concentrate on higher energy photons Improved attitude and aspect systems are being built

W81-70511 **188-46-57**
Jet Propulsion Laboratory Pasadena Calif
GAMMA-RAY ASTRONOMY
A S Jacobson 213-354-6263

This RTOP describes the JPL program in X- and gamma ray astronomy part of which is a cooperative effort with the Space Radiation Laboratory on the CIT campus The primary objective of the program is to observe nuclear gamma-ray line spectra from extraterrestrial sources in the 02 to 10 MeV energy range Such observations will provide important information on nucleosynthesis galactic structure and the physical nature of various celestial objects including cosmic X-ray and gamma-ray sources both constant and transient Under this program analysis of data from a previous balloon flight will be completed and published Additionally development of a new significantly larger balloon system will continue The specific objectives for this program for FY-81 are to continue the design of the next generation high spectral resolution gamma-ray telescope and to continue with the procurement of large volume high purity germanium crystals

W81-70512 **188-46-59**
Marshall Space Flight Center Huntsville Ala
X-RAY ASTRONOMY - TIME VARIABILITY AND POLARIMETRY
M C Weisskopf 205-453-5133

The objective is to conduct research in the field of X-ray astronomy in areas related to the Astrophysics programs of NASA in the following tasks (1) We will analyze and interpret existing satellite and ground-based observations of the time variability of the X-ray sources and their optical counterparts with emphasis on the black hole candidates Auto- and cross-correlation techniques shot model and pulse-shape-innovation techniques will be utilized to determine the underlying pulse shape and stability as a function of time (2) We will determine the degree of the contamination of the OSO-8 X-ray polarization data by solar X-rays polarized due to electron scattering This task will be accomplished by correlating solar intensity measurement obtained with an X-ray heliometer also aboard the satellite (3) We will design, build test and fly in a sounding rocket an advanced X-ray polarimeter The polarimeter will utilize the polarization dependence of the photoelectric effect and in particular the angular dependence of certain fluorescence photons on the linear polarization of the incident X-rays

W81-70513 **188-46-59**
Goddard Space Flight Center Greenbelt Md
X-RAY ASTRONOMY
E A Boldt 301-344-5853

Celestial X-ray sources have introduced us to rich new aspects of astronomy ranging from the millisecond bursts of hard X-rays coming from the innermost orbits of matter falling into a black hole to the beamed emission associated with accretion of matter onto a rapidly rotating highly magnetized neutron star The combination of large sensitive area low detector background high temporal resolution and nondispersive spectroscopy over a broad bandwidth has been our approach in discovering and exploring these phenomena The power of this approach is being well demonstrated Extending it with improved spectral resolution and broadband imaging is a major area of development now indicated This involves the creation and evaluation of new systems incorporating low noise ionization counters to optimum resolution large area X-ray concentrators and imaging devices such as CCD s Dispersive spectroscopy is introduced via the development of a conical crystal spectrometer

W81-70514 **188-48-51**
Marshall Space Flight Center Huntsville Ala
INTERDISCIPLINARY SPACE SCIENCE RESEARCH
C R ODell 205-453-3033

The objectives are to conduct space science research in various scientific and technical disciplines related to the astrophysics programs of NASA and to provide a quick-reaction capability of supporting research tasks unforseen or which encounter unexpected difficulties and which enhance the in-house scientific capabilities of the MSFC Under the direction of the Associate Director for Science research is initiated in astrophysics-related scientific and technical areas that support the scientific missions of the Center Research tasks selected for funding will contribute to the advancement of in-house capabilities and the state-of-the-art

W81-70515 **188-78-51**
Marshall Space Flight Center Huntsville Ala
LOW GRAVITY SUPERFLUID HELIUM ADVANCED TECHNOLOGY DEVELOPMENT
R Decher 205-453-5130

Several experiments are currently being developed which will require a low temperature environment for their proper operation in space Superfluid helium will undoubtedly be used for many of these applications Immediate application to experiments are to be found in cosmic ray relativity and infrared astronomy The purpose of this RTOP is to investigate theoretically and experimentally where possible the properties of superfluid helium to be expected when liquid helium dewars are flown into space The properties of superfluid helium in this near zero gravity environment will be assessed and methods will be investigated whereby problem areas may be resolved and/or controlled The goal of this effort is to support the development of liquid helium dewar technology for space

W81-70516 **188-78-51**
Goddard Space Flight Center, Greenbelt, Md
ADVANCED TECHNOLOGICAL DEVELOPMENT, GENERAL SIGNAL AND DATA PROCESSING ELECTRONICS, SOLID STATE DETECTORS
James H Trainor 301-344-6282

The objectives of this research project are to develop and test new on-board signal handling data processing storage computing and auxiliary electronics circuitry for use in energetic particle and astrophysics experiments on spacecraft rockets

balloons etc as well as special test and analysis equipment applicable also for both ground and shuttle usage The growing complexity of experiments and the often corresponding increase in the volume of data obtained have made signal handling data processing and data transmission capability-limiting factors To reduce the transmission of unnecessary data it is necessary to increase the experiment s on-board signal handling and data processing capability This program is approached through the investigation and development of new techniques for signal shaping and handling data processing and auxiliary circuitry and the modification of existing techniques by the application of advanced technology and materials including MOS/LSI technology thick film techniques multiple chip techniques and microprocessors The technical objective of the research project is to conduct a program of research and development and device test and evaluation in the field of silicon and germanium nuclear radiation detectors with emphaiss on (1) the improvement of detector technology (2) the understanding of the radiation damage effects on device operation and lifetime (3) the understanding of the effects on these detectors of chemicals commonly used near or on spacecraft (4) to establish the technology for the fabrication of specialized devices not available from industry and (5) to continue the pragmatic life testing

W81-70517 **188-78-60**
Marshall Space Flight Center Huntsville Ala
ADVANCED MISSION STUDIES
C C Dailey 205-453-4024

This RTOP covers studies related to astrophysics missions for the exploration of the electromagnetic radiation from space Examples are Advanced X-Ray Astrophysics Facility (AXAF) and other missions designed for X-ray research and the Optically Coherent Telescope Array for detail studies in the visible portion of the spectrum using extremely large arrays of reflectors Other studies in the area described by this RTOP will be incorporated as separate tasks as appropriate

Planetary Astronomy SR&T

W81-70518 **196-41-30**
Marshall Space Flight Center Huntsville Ala
COMETARY OBSERVATION AND THEORY
C R O Dell 205-453-3033
(188-41-51)

The objective is to obtain cometary spectra with intermediate spectral resolution between 350 to 820 nm with emphasis on the longer wavelength and to analyze rovibronic structure of the observed comets and spectra of comets in terms of a corrected resonance-fluorescence mechanism An Echelle spectrograph employing an S-20 fiber optics image tube with an F/2 Schmidt camera will allow a spectral resolution of approximately equal to 0 5 Angstrom to be obtained on photographic plates Standard data reduction by densitometry will be employed A review of laboratory and cometary spectra will provide the initial suggestions for correcting the resonance-fluorescence mechanism (e g NH2)

W81-70519 **196-41-40**
Lyndon B Johnson Space Center, Houston Tex
REMOTE SENSING OF PLANETARY SURFACES
A E Potter 713-483-5039

The objectives are to (1) identify and map silicates on the lunar surface, using silicate reststrahlen bands in the thermal emission spectrum of the Moon and to extend this approach to identification of silicates in comets and asteroids near the Sun and (2)to develop and apply instrumentation for multispectral imaging of the lunar surface at 32 bands in the 0 8-2 4 micron spectral range Current techniques obtain this data for only one site at a time making geologic mapping from spectral information a slow and difficult process Initial studies of the lunar reststrahlen bands have been done with a high resolution Michelson interferometer in order to locate the bands accurately and to obtain simultaneous water vapor and ozone data needed for atmospheric corrections A low-resolution spectrometer operated along with a water vapor and ozone meter would provide equivalent data with improved sensitivity and speed and this system will be built to replace the interferometer A linear array of lead sulfide infrared detectors to give spatial resolution is operated with a Michelson interferometer to give spectral resolution in the 0 8-2 4 micron spectral range Thirty two bands in the 0 8-2 4 micron range are produced by the current configuration Imagery can be produced by stepping the array over the lunar surface perpendicular to its long dimension

W81-70520 **196-41-50**
Goddard Space Flight Center Greenbelt Md
GROUND-BASED INFRARED ASTRONOMY
V G Kunde 301-344-5693

The scientific objective is to determine information on astrophysical objects such as molecular clouds interstellar lines molecular and circumstellar components in stellar atmospheres and planetary atmospheres from high spectral resolution ground-based measurements in the intermediate infrared A spectrometer system employing a cryogenic Michelson interferometer (77K) is being developed to meet the simultaneous requirements of high spectra resolution a wide free spectral range and high sensitivity An optical retardation up to 25 cm will provide an unapodized spectral resolution up to 02/cm in the 400-2000/cm range A post-dispersed detection system is being developed to reduce background noise from a warm telescope system and the atmosphere at the detector thus allowing the multiplex advantage of the interferometer to be retained The cooled instrumentation with the post-dispersed detection system operating at a favorable infrared site will allow maximum sensitivity to be attained for an interferometer system at a ground-based site The sensitivity level for a measurement in the 1000/cm (10 microns) region with a 122 cm diameter telescope an integration time of 60 minutes and a spectral resolution of 0 2/cm is approximately 5 x 10 to the minus 26th power watts/sq m/hz The s/n level for Jupiter in the 1000/cm region with the above system is approximately 7 for one minute integration time and full spectral resolution of 0 02/cm Initial observations will be made during FY 81 with a discrete detector system with sensitivities approximately 5-10 lower than for the post-dispersion system

W81-70521 **196-41-51**
Goddard Space Flight Center Greenbelt Md
RADIO AND RADAR PLANETARY STUDIES
J K Alexander 301-344-5461

The objective of this program is to obtain information on the nature extent and dynamical behavior of planetary magnetic fields trapped radiation belts and magnetospheres by studying the nonthermal radio emissions from the planets The major approaches to this investigation are (1) synoptic observations of Jupiter s decametric radiation via a global network of monitoring instruments and (2) theoretical analysis of the generation and propagation of nonthermal radiation in a planetary magnetosphere The Jupiter Monitor Network has provided unique data relative to the rate and stability of the magnetic field rotation energetic particle trapping and precipitation processes and the physics of the satellite-plasma interactions in the magnetosphere and correlative data both for other ground-based observations and fly-by in-situ measurements

W81-70522 **196-41-52**
Goddard Space Flight Center Greenbelt Md
IMAGING STUDIES OF COMETS
John C Brandt 301-344-8701

This project provides for the operation of a small high altitude observatory Joint Observatory for Cometary Research (JOCR) for imaging research on comets and their interactions with solar radiation and the solar wind This research is carried out with ground-based images alone or if suitable data from spacecraft such as Solar Polar Mission is available with an appropriate combination of ground-based measurements It should be noted that funding provides support for the operation of the observatory only analysis of research results is funded

by the interested Program Office In addition, when suitable bright comets appear radio observations will be made at existing national facilities and other visible wavelength observations will be carried out at other suitable facilities The observatory site in central New Mexico is one of the darkest sites left in the continental U S Extensive photography of comets Kohoutek Koboyski-Berger-Milon and West has been carried out These photographs show extensive features in the plasma 0 1 a u from the head which have been analyzed for phase speed and estimates of the tail magnetic field A structure in comet Kohoutek on January 20 1974 was associated with a specific excursion in the polar solar-wind speed this is a first

W81-70523 **196-41-54**
Goddard Space Flight Center Greenbelt Md
ADVANCED INFRARED ASTRONOMY AND LABORATORY ASTROPHYSICS
M J Mumma 301-344-6994
(188-41-55 154-50-80)

The objective of the advanced infrared astronomy program is to study the molecular constituents of solar system objects (e g planetary atmospheres and comets) through observations of their IR line spectra and so to further our knowledge about (1) molecular abundances (2) kinetic vibrational and rotational temperature distributions (3) kinetic velocity shifts (winds) (4) vertical and spatial distributions and (5) ambient gas densities and to carry out comparative studies of these projects The physical information sought is contained in the intensity profiles of isolated spectral lines and can be obtained by inversion of the observed line shapes The measurement of spectral line shapes has recently become a tractable problem at IR wavelengths and line shapes can now be measured by infrared heterodyne spectroscopy The approach is to develop and employ coherent detection line receivers for use in the infrared wavelength regions The infrared optics incorporate either gas lasers or semi-conductor diode lasers as local oscillators and HgCdTe photo-mixers The intermediate frequency signal is fed into a GSFC standard spectral line receiver which analyzes displays and outputs the spectral lines Initial observations with this system have been from the ground but it has been developed with an eye toward flights on the NASA C-141 and in space Laboratory work on precise line frequency determinations and on pressure broadening effects is also carried out in support of the field experiment (see also RTOP 188-41-55 and 154-50-80)

W81-70524 **196-41-68**
Ames Research Center Moffett Field Calif
DETECTION OF OTHER PLANETARY SYSTEMS
D C Black 415-965-5495

The long-range objective of this activity is to develop a comprehensive program to detect other planetary systems The near-term objectives include the funding of selected university researchers to pursue modest exploratory developmental and observational programs as well as theoretical studies directed at identifying optimum techniques for ground-based planetary detection systems The choice of university researchers will be based on a peer review of unsolicited proposals and it will be guided by the basic recommendations set forth in Volume 1 of NASA CP-2124 Funding will also be used to support in-house theoretical research at Ames Research Center related to the detection and study of other planetary systems

W81-70525 **196-41-71**
Jet Propulsion Laboratory Pasadena Calif
OPTICAL ASTRONOMY
T V Johnson 213-354-7427

The overall objective of the ground-based optical astronomy task is physical study of planets and their satellites by means of ground-based observations at visible and near-infrared wavelengths (approximately 0 3 to 2 0 mu This task consists of several subtasks (1) investigation of the physical and chemical properties of the upper tropospheres of Venus Jupiter Saturn Uranus and Neptune through high resolution astronomical spectroscopy and spectrophotometry (2) investigation of the physical state and bulk motions of the neutral sodium cloud associated with Io through a variety of advanced high resolution spectroscopic techniques and investigation of the temporal and spatial behavior of the Na D-line emission from the Jovian satellite Io (J-1) through a synoptic program of spectroscopic observations and (3) investigation of the temperature and density of low energy thermal ions in Jupiter s magnetosphere In addition to these primary subtasks the ground based optical astronomy task provides limited operational support (equipment maintenance and setup observing assistance) at Table Mountain Observatory (TMO) to programs supported from other sources

W81-70526 **196-41-72**
Jet Propulsion Laboratory Pasadena Calif
INFRARED ASTRONOMY
R Beer 213-354-4748

The objective of this program is to understand the physical and chemical state of planetary atmospheres by means of chemical and isotopic abundance analyses as determined by spectroradiometric remote sensing methods in direct support of ongoing and planned planetary missions The principal approach employed is that of high-resolution near infrared (1 to 6 micrometer) astronomical spectroscopy using a Connes -type Fourier spectrometer at the coude focus of the 3 m IRTF on Mauna Kea Hawaii At the present time the equipment is in the final stages of preparation for its removal from JPL and shipment to Hawaii Test observations will be made during the remainder of the current FY-80 in preparation for a full-scale resumption of activity in FY-81

W81-70527 **196-41-77**
Jet Propulsion Laboratory Pasadena Calif
PLANETARY INFRARED IMAGING
Richard J Terrile 213-354-6158

The objective of this program is to provide high spatial resolution ground-based infrared and visible images and spectra of the Jupiter and Saturn systems These data directly support instrumentation on the Voyager missions to Jupiter and Saturn and the proposed Galileo mission to Jupiter Jupiter will be observed in the 5 micrometer window into the deep atmosphere as a continuation of a very successful program to monitor Jovian weather patterns throughout the Voyager post-encounter period Saturn will be observed at various infrared wavelengths in order to determine if atmospheric features seen from the ground can be correlated with those observed by Voyager instruments The suitability and philosophy of targeting the Voyager 2 Imaging Science and Infrared Interferometer Spectrometer (IRIS) experiment will also be determined Imaging data collected with a CCD coronagraph at 8900 A and scan data in the infrared at 2 2 micrometer will allow targeting Voyager observations of Saturn s E-ring and provide ground-based information on Jupiter s newly discovered ring and satellite 1979 J1 Observations will be made with an existing infrared imaging system at the Hale 5 meter telescope at 1-5, 8-14 and 20 micrometer and scans will be acquired at the 3-meter NASA-IRTF at Mauna Kea Observatory The CCD images will be acquired from the Palomar 5-meter and 1 5-meter telescopes using an existing camera and data analysis facility at Caltech A Connes-type Fourier spectrometer is also expected to be operational at Mauna Kea Observatory and will be used to provide high spectral and moderate spatial resolution data of Jupiter Saturn and Titan in the infrared Simultaneous infrared imaging will also be attempted during spectroscopy runs

W81-70528 **196-41-78**
Jet Propulsion Laboratory Pasadena Calif
EARTH BASED SOLAR SYSTEM OBSERVATIONS
Torrence V Johnson 213-354-7427

The work is aimed at investigating lunar, asteroidal and planetary physical and chemical properties using a variety of ground-based advanced techniques One task utilizes the Silicon Imaging Photometer System (SIPS) to acquire multispectral data of various lunar regions The basic objective is to correlate such spectral data with orbital and other ground-based data sets both as part of the La Jolla Consortium and as part of the PSI Basaltic Volcanism Project It also provides for infrared imaging capability involving simultaneous 5600 A/2 2 micrometers imaging of the lunar near side surface with approximately 10

resolution together with imaging of particular locations at other IR wavelengths The near infrared region is used since there are diagnostic reflectance features present to distinguish among rocks immature soils and mature soils Another task is the acquisition and processing of intercontinental delta VLBI observation between lunar ALSEP transmitters and extragalactic radio sources (ERS) The ALSEP/Quasar observations employ a three antenna' technique in which the differential phase is obtained with sufficient signal to noise ratio for processing at the Caltech/JPL correlator The objectives are to tie the lunar orbit to the ERS reference frame to test gravitational theories and to measure various lunar bulk physical properties The development of this technique is also important for eventually tying the planets to the ERS reference frame

W81-70529 **196-41-80**
National Aeronautics and Space Administration Washington D C
GROUND-BASED OPTICAL PLANETARY ASTRONOMY
William E Brunk 202-755-3660

The object of this research is to increase our knowledge of the planets their satellites asteroids and comets through the use of astronomical observations made with telescopes and other optical instruments located at ground based observatories The observations will be made throughout the visible and infrared portions of the spectrum Reduction, interpretation analysis and publication of the data thus obtained are included as part of the objective The interest experience and facilities of scientists outside of NASA will be utilized to obtain data needed to support and supplement the planetary flight program The program included under this RTOP covers observational studies of the planets their satellites asteroids and comets in the optical and infrared portions of the spectrum made from gound based observatories The results of these studies are published in the open literature The planetary science expertise and observational facilities required for this program are in general not available within the NASA centers

W81-70530 **196-41-81**
National Aeronautics and Space Administration Washington D C
ASTRONOMICAL OPTICAL INSTRUMENT DEVELOPMENT
William E Brunk 202-755-3660

The object of this research is to design develop and construct auxiliary instrumentation to be used for ground based astronomical observations The auxiliary instrumentation includes such items as cameras photometers spectrometers and interferometers The scientific return that can be obtained under RTOP 196-41-80 is limited by the instrumentation available to the investigators The actual level of scientific return possible from ground based observations in the optical and infrared could be much higher if additional instrumentation is developed under this task when the magnitude of the development is too great to be considered as part of the research task Upon completion these instruments are to be used for research programs under RTOP 196-41-80

W81-70531 **196-41-84**
National Aeronautics and Space Administration Washington D C
LABORATORY SUPPORTING STUDIES (ASTRONOMY)
William E Brunk 202-755-3660

The object of this research is to obtain laboratory data required for the analysis and interpretation of planetary observations made from the vicinity of the Earth The data obtained will be of two types first detailed study of gases and other materials known to exist on a planet and second study of the properties of many possible materials to try to explain unidentified features detected in planetary observations The data obtained under this program will be published as well as being used directly in the interpretation of new observations Principal investigators on tasks under RTOP 196-41-80 frequently find that there is insufficient laboratory data on the spectra of the molecular constituents they are observing Needed are data for specific molecules at conditions and wavelengths not normally encountered in laboratory studies It is therefore necessary to obtain the needed data using specialized very long path absorption cells at a range of temperatures and pressures

W81-70532 **196-41-85**
National Aeronautics and Space Administration Washington D C
GROUND-BASED RADIO AND RADAR PLANETARY ASTRONOMY
William E Brunk 202-755-3660

The object of this research is to determine planetary properties by observations from ground based observatories at radio wavelengths Both passive (radio) and active (radar) observations will be performed The program will include the reduction analysis and interpretation of the observations The interest experience and facilities of scientists outside of NASA will be utilized to obtain data needed to support and supplement the planetary flight program The program included under this RTOP covers observational and the associated theoretical studies of the planets their satellites and other members of the solar system in the radio portion of the spectrum made from ground based observatories Both passive radio astronomy and active radar astronomy observing techniques are included under this RTOP The results of these research programs are published in the open literature The planetary science expertise and observational facilities used in this program complement those available within the NASA centers and the Jet Propulsion Laboratory

W81-70533 **196-41-85**
National Aeronautics and Space Administration Washington D C
THEORETICAL PLANETARY ASTRONOMY
William E Brunk 202-755-3660

The The object of this research is to provide theoretical support for the planetary astronomy program by predicting what data should be observed and by explaining the observational results both predicted and unexpected The program also involves the integration of observational and laboratory results from many sources to provide an explanation of planetary phenomena Thus this program provides an important link between the observational and laboratory programs and an understanding of the planets Based on prior knowledge of the planets and existing physical laws programs are undertaken to predict the observational data on the planets As an example theoretical atmospheric spectra are generated using assumed knowledge of the planetary atmospheric constituents the spectral effects produced by a scattering atmosphere containing aerosols and the dispersion of the observable spectra Comparison of the observed spectra with the theoretically calculated spectra tests the assumptions used in the theoretical calculations

Life Sciences SR&T

W81-70534 **199-10-10**
Lyndon B Johnson Space Center Houston Tex
OPERATIONAL LABORATORY SUPPORT
W H Shumate 713-483-4461

The objective of the Operational Laboratories Support is to provide medical operations support by the Johnson Space Center (JSC) Ames Research Center (ARC) and Kennedy Space Center (KSC) to approved Agency programs The medical operations support provided includes the conduct of studies to investigate countermeasures to physiological changes which occur when man is exposed to the space flight environment clinical laboratory support of astronaut health programs pre- and postflight testing of astronauts and operational tests and studies of the spacecraft environment life support equipment, habitability systems and medical procedures and support equipment The approach utilized to accomplish this objective is to maintain discipline oriented laboratories in each of the physiological problem areas covered by the Life Sciences SR&T RTOP Program The funds will be provided for laboratory staff equipment supplies and data management support to accomplish the operational medicine goals and objectives of the Agency

W81-70535 **199-10-20**
Lyndon B Johnson Space Center Houston Tex
MEDICAL SELECTION CRITERIA (MEDICAL EVALUATION AND DEVELOPMENT OF STANDARDS FOR SPACE CREW SELECTION)
S L Pool 713-483-4461

The objective of the research covered by this RTOP is to conduct longitudinal retrospective and prospective studies of the medical data on individuals who have flown in space and some cohorts who have not The studies covered involve individuals in a closed population in an attempt to relate characteristics of the individual to the absence of or the development of disease conditions The epidemiologic study of diseases that may not be recognized clinically for several years is often very difficult However as other studies such as the Framingham study have demonstrated it is possible to isolate certain responsible host and environmental factors by means of well organized epidemiologic surveys which may span several decades in time A vast amount of clinical data was collected on individuals who have flown in space This is particulary true of pre- and post-flight phases of those missions however some data was collected in space flight This data was obtained as a result of both operational requirements as well as experimental studies conducted during space flight The necessity for further understanding the interaction between man and his environment in space is responsible for continuous generation of a variety of different types of medical data which will be collected during the shuttle flights

W81-70536 **199-10-30**
Lyndon B Johnson Space Center Houston Tex
CREW HEALTH MAINTENANCE
C F Sawin 713-483-4264

Maintenance of crew health has always been the primary objective of medical treatment associated with the manned space flight program Early portions of the program were empirical in nature Man was exposed to the space environment for increasing durations with extensive postflight testing to quantitate physiological changes No specific evidence exists to support early concerns that there would be pathological changes associated with exposure to the environment of space Instead a fairly consistent pattern of adaptation to microgravity has evolved with the successful completion of the Mercury Gemini and Apollo and Skylab Programs Certain areas of physiological change lend themselves to intensive study during the relatively short duration (7-10 days) of early shuttle flights Other known changes (e g -bone demineralization) can best be studied on long duration missions One important area to be investigated is the requirement for inflight crew exercise This effort is extremely important because crew time is a limited mission resource Past experience shows that crewmen desire to exercise 1 5 hours daily to maintain their fitness Some quantitative losses in leg strength occured even with that amount of inflight exercise One goal is to provide a logical defensible reduction in flight crew exercise requirements This must be accomplished without imparing crew performance

W81-70537 **199-10-41**
Lyndon B Johnson Space Center Houston Tex
SYSTEMS HABITABILITY VERIFICATION
James M Waligora 713-483-5457

A large portion of biomedical research conducted as part of the Space Program has to do with the effect of space specific environments on man and other organisms What may be less obvious as a potential problem is that the environment that man is exposed to in space is almost entirely a man-made environment Many environmental factors that are relatively constant in the Earth s atmosphere such as O2 and CO2 concentration and pressure must be carefully controlled by environmental control systems in the space vehicle Acceptable control ranges and emergency ranges for environmental factors must be specified and it must be verified that the spacecraft can maintain the environment within these specifications The specifications must provide for the safety and well-being of the crew and must also provide an environment stable enough to allow biomedical study of the space-unique environmental factors In arriving at specifications for these environmental factors considerations must given to the difficulty involved in controlling a given environmental factor within a given control range and the implications in terms of cost weight and reliability Defining these limits and verification that the limits are met in the spacecraft will require research in specific areas

W81-70538 **199-20-00**
Lyndon B Johnson Space Center Houston Tex
SPACE MOTION SICKNESS
J L Homick 713-483-5457

The overall objective of this research program is to produce the information required to solve the problems of space motion sickness and neurosensory adaptation to the weightless space flight environment A broad based program of interrelated studies will be undertaken to delineate the etiology of the space motion sickness syndrome and to develop effective measures for its prediction prevention and treatment

W81-70539 **199-20-50**
Lyndon B Johnson Space Center Houston Tex
BLOOD ALTERATIONS (INFLUENCE OF SPACE FLIGHT ON THE BLOOD-FORMING TISSUES)
C S Leach 713-483-4086
(199-20-60)

The most significant effect of the space flight environment observed relative to the blood and blood-forming tissues in man has been a consistent reduction in the circulating red blood cell mass during the flight interval The variations in the magnitude of the loss in individual crewmen and the complicated postflight recovery kinetics suggest a complex relationship between the red cell mass loss and the duration of the exposure to weightlessness This anemia of space flight was frequently accompanied by a reduction in plasma volume apparently occurring early in the mission and sustained throughout the flight Other more subtle effects were observed with respect to the function and structure of red blood cells and of lymphocytes and in the concentration of some plasma proteins The major emphasis of this research program will be to address questions relative to the regulation of blood volume during space flight and the causes of its apparent failure The primary objectives will be to elucidate the mechanisms and etiology of the alternations in red cell mass and plasma volume and to determine the significance of these changes in limiting man s (both astronaut and nonastronaut) participation in space flight activities associated with the shuttle Program

W81-70540 **199-20-60**
Lyndon B Johnson Space Center Houston Tex
FLUID AND ELECTROLYTE CHANGE
Carolyn S Leach 713-483-4086

Body fluid compartment shift occurs in early exposure to weightlessness These changes are complicated by losses in electrolytes (sodium potassium calcium phosphorus magnesium and chloride) occurring at a slower rate over mission duration which further influence fluid distribution Hormonal responses are elicited to counteract these changes The purpose of this program will be to study these changes and their effect on man s (astronaut and non-astronaut) ability to function in space Results of the investigations will provide an understanding of the physiological and biochemical effects of weightlessness and rationale for nutritional and/or other countermeasures for use in future space flight missions The information gained from exposure of man to weightless flight for periods approaching 3 months has shown that fluid and electrolyte metabolism has been altered in all crewmen studied It is apparent that the changes experienced are multiphasic and are caused not only by the weightless environment but also by conditions related to the preparations for flight the activity during flight and the recovery procedures The overall objective of this research program is the elucidation and definition of biochemical agents and physical factors operative in the processes associated with fluid and electrolyte metabolism in the space flight environment

W81-70541 **199-20-70**
Lyndon B Johnson Space Center Houston Tex
RADIATION EFFECTS AND PROTECTION
C M Barnes 713-483-5281

This RTOP presents the initial stage of a restructured long-term program of research on the space ionizing radiation environment and its consequences for manned space operations While currently available information is sufficient for early shuttle missions research priorities of the attached program are based on the assumption that NASA s long-term plans will involve man in geostationary orbit before the year 2000 Based on knowledge obtained from previous research under this RTOP exposure to ionizing radiation may be the limiting factor in both mission duration and total career for the crew Furthermore shielding considerations especially for protection from solar flares may influence significantly the detailed design and total mass of a spacecraft To provide timely solutions to these problems in the mission planning stage the underlying research must be initiated now A plan is presented for research in the specific areas of radiobiology radiation environment and radiation protection

W81-70542 **199-50-94**
Jet Propulsion Laboratory Pasadena Calif
PLANETARY PROTECTION PROGRAM
Maryin Christensen 213-354-9627

The present Planetary Protection (PP) Program is based on existing international national and NASA agreements For years the primary thrust of the program has concentrated on the exploration of Mars Now that the Viking mission has concluded the program guidelines need to be re-evaluated by the NASA the National Academy of Science s Space Science Board and others including JPL PP Office This evaluation will focus on the validity of the present approach particularly in view of recent planetary data This information must be set in the perspective of the proposed NASA mission model inclusive of missions within the next ten years Where the data are supportive consideration will be given to modification or deletion of present policies Since the program basis is established in treaty obligations (in which NASA played a key role in developing) care must be taken in revising these obligations within an appropriate framework Additionally some effort will be directed toward NASA/OSS s role in the protection of life science experimentation Millions of dollars are spent in instrument development however NASA has no focal point to assure itself that contamination will not degrade or prevent the instrument from making planned observations and measurements As a final programmatic element consideration will be given to missions on the horizon for which PP requirements are unclear or for which the requirements could pose significant problems in authorization of the program Sample return missions clearly fall into this category Items identified as requiring a long lead time for resolution should be addressed at a low but consistent level

W81-70543 **199-60-60**
Jet Propulsion Laboratory Pasadena Calif
MAN-MACHINE SYSTEMS
A K Bejczy 213-354-4568
(199-60-80 506-54-85 906-75-27)

The general objective is to develop basic understanding for critical man-machine system interface elements from the viewpoint of human capabilities and behavior taking into consideration man s anticipated role in working with machines operated in space In the terminology of modern information/control machines man is essentially a single channel processor although he is equipped with multiple input/output capabilities There is a need to quantitatively understand man s present and future functional role in the expanding world of modern machines and accommodate man s capabilities accordingly The near-term objective is twofold (1) expand man's capabilities to communicate with machines and (2) study and develop general techniques suitable to evaluate man s perceptive/cognitive performance in interacting with machines on the symbolic level The general approach is to study and evaluate the utility of modern techniques in (1) machine recognition of human speech and (2) machine recognition of human perceptive/cognitive responses to symbolically presented tasks under varying workload conditions The specific FY-81 goal is twofold (1) to experimentally study machine recognition of connected speech for man-machine command/control communication and (2) to conduct experimental evaluation of modern psychophysiological techniques in detecting multiple perceptive/cognitive responses from event-related potential wave measurements on the human scalp The first task will utilize capabilities existing at the JPL teleoperator laboratory in machine recognition of discrete words and will also utilize a speech recognition frame developed at Carnegie-Mellon University and evaluated at JPL previously The second task is a logical continuation of work performed in FY-80 jointly with the University of Illinois to detect single perceptive/cognitive responses from event-related potential measurements It is planned to perform the multiple response measurements jointly with UCLA in FY-81

W81-70544 **199-60-71**
Lyndon B Johnson Space Center Houston Tex
MAN-MACHINE ENGINEERING REQUIREMENTS FOR DATA AND FUNCTIONAL INTERFACES
J L Lewis 713-483-4966

The objectives of this research are to move toward quantification of man-machine engineering data both on the ground and in flight to continue to pursue state-of-the-art technology and to advance that technology for the purpose of creating more effective and efficient man-machine interfaces for manned spacecraft and to improve techniques of man-machine engineering design so that innovative steps may be taken toward creating better crew interfaces in future vehicles The approach will be to implement a series of continuing tasks to identify and implement workable instrumentation packages for acquiring quantitative man-machine engineering data in one-g simulated zero-g and actual zero-g to continue those efforts currently defined that lead toward definitive design requirements for use as inputs to the Design Performance Lab and to pursue feasibility studies of promising new crew interface items

W81-70545 **199-60-80**
Jet Propulsion Laboratory Pasadena Calif
ADVANCED TELEOPERATION STUDIES
A K Bejczy 213-354-4568
(199-60-60 506-54-85 906-75-27)

The general objective is to develop basic understanding of remotely manned systems so that space missions requiring the use of such systems can be planned and implemented with the required reliability performance and economy The specific objective is to develop conceptual designs and breadboards in order to study determine and evaluate the complementary roles of man and machine in teleoperated systems The specific FY-81 objectives are (1) to determine and evaluate the anthropometric and anthropomorphic parameters for kinesthetic coupling of man to a remote manipulator (2) to determine and evaluate the ramifications of symbolic versus analog or combined symbolic and analog communication between man and remote manipulator and (3) to determine and evaluate man s perceptive/cognitive command/control effectiveness for varying presentations of remote control task scenarios moving versus static absolute versus relative integrated versus compartmentalized etc The experimental studies will utilize laboratory breadboard elements developed previously at JPL The results will be documented in scientific papers and reports The approach is to conduct experimental studies on various functions of teleoperated systems The experimental studies will give insight into the functions to be performed by man or machine or both for remote explorations or operations Function allocation will be utilized between man and machine for various operational constraints including time delays in order to study system performance and identify needs for new subsystem developments New system or subsystem concepts will be developed and breadboarded when apporpriate for feasibility and performance evaluation studies

W81-70546 **199-70-31**
Lyndon B Johnson Space Center Houston Tex
GLOBAL TERRESTRIAL ECOLOGY
D S Nachtwey 713-482-5281
(199-20-71)

The objective to this program was to investigate and define

the extent of the impact on human health and the biosphere that may be caused by increased ultraviolet radiation resulting from stratospheric ozone layer reduction by space transportation systems (STS) operations and other potential NASA activities This activity is being phased out during FY-80 A new additional objective is to examine the feasibility of establishing a program in global ecology This RTOP will be rewritten at Hqs during FY-80 to reflect this new direction

W81-70547 **199-90-71**
Lyndon B Johnson Space Center Houston Tex
INTERDISCIPLINARY RESEARCH
Lawrence F Dietlein 713-483-6291

The Life Sciences Directorate at Johnson Space Center is responsible for the development of a comprehensive biomedical research program in support of manned space flight This broad multidiscipline mandate to acquire new knowledge is directed toward the acquisition of definite data regarding the effects of the space environment on life systems in order to define the critical physiological and psychological variables which must be integrated into the overall considerations of spacecraft designers and mission planners The objective of the interdisciplinary research RTOP is to provide flexibility in the accomplishment of this goal

Solar Terrestrial Spacelab Payload Definition

W81-70548 **356-36-01**
Marshall Space Flight Center Huntsville Ala
SPACE PLASMA PHYSICS
W C Snoddy 205-453-3430

The objective of this RTOP is to address and define space plasma investigations through several diverse approaches The experiments and studies are as follows (1) by active injection and observation of chemical tracers into the Earth-Space Environment (2) to provide scientific and engineering support to the Active Experiments Working Group and (3) by definition of investigations and instruments for the early Tethered Satellite System flights (2 Tasks) This RTOP also supports the development and dissemination of research results and information on the SolarTerrestrial Environment

W81-70549 **356-38-01**
Marshall Space Flight Center Huntsville Ala
ADVANCED MISSION STUDY - SOLAR X-RAY PINHOLE SATELLITE AND LONG FOCAL LENGTH CORONAGRAPH
J R Dabbs 205-453-3430

Hard X-ray imaging (10 - 100 keV) from solar flares will contribute not only to our knowledge of the sources directly associated with the chromospheric manifestations of flares but will also help us to explore the corona A solution to the problem of achieving significantly better angular resolution for hard X-rays lies in the pinhole experiment concept An equally important use of the pinhole satellite will be its application as an external occulter for coronagraph observations of the solar corona Previous feasibility studies have investigated alternative stabilization techniques and preliminary optical systems design for a long focal length coronagraph which will be flown on Spacelab mission utilizing a boom deployed occulting and aperture mask Separations on the order of 50 meters could afford sub arc second X-ray imaging of the Sun and also provide highly effective occultation experiments in both visible and UV regions The spacelab facility is expected to mature into longer focal length facilities either adjunct to the space platform or as separate free flyers

W81-70550 **356-78-01**
Marshall Space Flight Center Huntsville Ala
SPACELAB SCIENCE PAYLOADS DEFINITION ATD - GENERAL
W C Snoddy 205-453-3430

The purposes of this RTOP are to conduct studies perform assessments and develop systems to enhance Solar Terrestrial Investigations thru the use of Spacelab and its evolution to space platforms These studies will be directed towards the scheduling and grouping of candidate experiments assessment of programmatic and physical accommodation requirements for science instruments Operations planning definition of data systems and other necessary support systems for science instruments on Spacelab and evolving platforms will be performed

Astrophysics Spacelab Science Payload Definition

W81-70551 **358-41-06**
Ames Research Center Moffett Field Calif
DEVELOPMENT OF SHUTTLE INFRARED TELESCOPE FACILITY (SIRTF)
L S Young 415-965-6546

The objective of this RTOP is to develop the shuttle infrared telescope facility (SIRTF) to develop scientific instruments for the SIRTF focal plane and to operate SIRTF as a facility on Spacelab SIRTF will provide a reflyable facility that will accept multiple focal plane instruments for use by infrared astronomers during the shuttle era The conceptual design of SIRTF has been the subject of several studies and the shuttle/Spacelab accommodations and SIRTF flight operations have also been studied Scientific instrument concepts and their accommodation in SIRTF have been studied by teams of astronomers The conceptual studies have identified the key technologies for SIRTF and for future instruments beyond the current state of the art and technology development in those areas is being conducted The conceptual studies were sufficiently detailed to allow cost estimates for SIRTF to be made The approach for this RTOP is to (1) complete development of the technology needed for the design and development of SIRTF for the first two missions and (2) to coordinate the results of previous studies and the technology development and to increase the depth of the design definition by performing a phase B study

W81-70552 **358-78-01**
Marshall Space Flight Center Huntsville Ala
SPACELAB SCIENCE PAYLOAD DEFINITIONS ATD - GENERAL
W C Snoddy 205-453-3430

In recent months the Astrophysics Division of the Office of Space Sciences has been developing the needs and requirements for the evolution of Spacelab experiment and payload to low-Earth orbit Science and Applications Space Platforms (SASP) Based on input from potential users and NASA planning activities preliminary mission models for potential space platform missions and preliminary space platform concepts were developed to determine if platforms were technically feasible Consequently a Science and Applications Space Platform Conceptual Design Study has been initiated by NASA along with a redevelopment of the user needs and requirements The objectives of this RTOP are to firmly establish the astrophysics accommodation requirements for a space platform system and to determine the advantages and/or disadvantages to astrophysics programs To accomplish these objectives payload accommodations assessment analysis of the astrophysics requirements will be carried out and operational scenarios will be developed

W81-70553 **358-78-60**
Jet Propulsion Laboratory Pasadena Calif
STUDY OF LARGE DEPLOYABLE ANTENNAS FOR ASTRONOMY APPLICATIONS
Paul N Swanson 213-354-3273
(540-01-15)

The objective of this RTOP is to develop a conceptual design for a large (10 to 30 m diameter) depolyable parabolic reflector for use in submillimeter and far-infrared astronomy Such a telescope is intended to provide high angular resolution and large collecting area in a wavelength range in which ground-based observations are prevented or gravely impeded by atmospheric absorption and emission It will complement in capability ground based telescopes for adjacent wavelength ranges (millimeter near infrared) now operating or planned for the next decade While astronomy provides the prime motivation for this RTOP other applications may exist in space communications and remote sensing The fact that this program is based strongly on technology developed with DARPA funding is evidence of other potential applications The approach in cooperation with the Ames Research Lab will be to use the results of the FY-80 study (which included a subcontract with Lockheed) to develop one (or a few) reflector concept(s) which will incorporate the most promising technologies relevant to mechanical configuration

surface materials active control and surface measurement Various trade-offs such as diameter versus minimum wavelength both functions of costs will have to be made A science workshop will be convened which will address these trade-offs in the light of scientific priorities A recommended conceptual design will then be developed which will maximize the scientific return with the bounds of reasonable cost and high-confidence technology

Solar Terrestrial Data Analysis

W81-70554 **385-36-01**
Goddard Space Flight Center Greenbelt Md
ATMOSPHERE-IONOSPHERE-MAGNETOSPHERE INTERACTIONS
R E Hartle 301-344-8234

The basic objective is to study the observed properties of the inner magnetosphere ionosphere mesosphere and thermosphere to identify and understand the physical and chemical processes operating in these regimes emphasizing how they interact This is achieved by processing analyzing and interpreting experimental data derived largely from flight programs after funding from project offices has terminated permitting the study of long-term phenomena comparison of data with new theories and models correlative studies of data obtained from various satellites and ground based observatories and the deposition of additional data in the National Space Science Data Center The essential data to be used in this investigation include electron densities and temperatures ion and neutral composition neutral winds ion temperatures and drifts electric fields magnetic fields electromagnetic radiation and energetic particles of magnetospheric and ionospheric origin These data are used to determine the various interrelated chemical compositional dynamical and energetic states of the inner magnetosphere ionosphere thermosphere and mesosphere and the transport and deposition of mass momentum and energy in and between these physical regions These basic properties and processes are then used to analyze specific geophysical phenomena such as electric field induced ion drifts in the ionosphere and inner magnetosphere chemistry and dynamics of mid and high latitude troughs auroral substorms ionospheric storms Joule heating PCA events tidal and gravity waves depletion and filling of plasmasphere ionospheric plasma resonances equatorial bubble formation SAR Arcs ring current decay etc

W81-70555 **385-36-01**
Marshall Space Flight Center Huntsville Ala
MAGNETOSPHERIC DATA ANALYSIS
C R Chappell 205-453-3036
(170-36-55)

The objective is an adequate understanding of the dynamics of low-energy plasma in the earth s magnetosphere through (1) analysis of the light ion mass spectrometer data from the NASA/DOD SCATHA Satellite (2) laboratory simulation of plasma flow around different objects (3) analysis of data on plasmasphere temperature and dynamics (4) analysis of data and development of models relating to the effects of spacecraft plasma sheaths upon low-energy charged particle data and (5) development of multispacecraft merged data sets and advanced display techniques

W81-70556 **385-36-01**
Ames Research Center Moffett Field Calif
PIONEER 6-11 PLASMA DATA ANALYSIS
J D Mihalov 415-965-5516
(170-36-55)

This research provides for analysis of solar wind plasma data from Pioneers 6 through 11 The solar wind proton and helium parameters including proton temperature anisotropy are obtained from the plasma analyzer data using least squares fitting computer programs Gradients of solar wind parameters with heliocentric distance are determined using data from Pioneers 10 and 11 Solar wind plasma time variations are also correlated with scientific data from other spacecraft and with Earth based observations to study the steady and dynamic characteristics of the solar plasma flow and the solar wind-geomagnetic field interaction Data analysis and averaging programs are maintained Data is supplied in various forms to co-investigators

W81-70557 **385-36-02**
Goddard Space Flight Center Greenbelt Md
DATA ANALYSIS - SPACE PLASMA PHYSICS
J K Alexander 301-344-5461

The basic objective is to study the observed properties of the interplanetary medium and the magnetosphere and to identify and understand the physical processes operating in these regimes including how they interact This is achieved by processing analyzing and interpreting experimental data derived largely from flight programs after funding from project offices has terminated permitting the study of long-term phenomena comparison of data with new theories and models correlative studies of data obtained from various satellites and ground-based observatories and the deposition of additional data in the NSSDC The essential data to be used in this investigation include magnetic fields plasma waves energetic particles plasma and kilometric radiation These data are used to determine the various dynamical and energetic states of the interplanetary medium and the magnetosphere and the transport and deposition of momentum and energy within and between these physical regions These basic properties and processes are then used in the study of specific geophysical phenomena such as interplanetary current sheets energetic particle acceleration and magnetic fields and plasma in the magnetosheath and the magnetotail Basic theory complementary effort is carried out in the areas of kinetic plasma physics and the motion of charged particles in electromagnetic fields

W81-70558 **385-36-04**
Goddard Space Flight Center Greenbelt Md
ENERGETIC PARTICLES AND PLASMAS IN THE MAGNETOSPHERES OF JUPITER AND SATURN
T G Northrop 301-344-7736

The objective of this study is to gain an understanding of the sources sinks and dynamics of energetic (> 0 1 MeV) ions and electrons in the magnetospheres of Jupiter and Saturn This work will apply plasma theory and the theory of charged particle motion to data taken by Pioneers 10 and 11 and by the Voyagers Included in the dynamics will be a study of the observed effects of moons in the fluxes and deduction of diffusion coefficients from these observations

W81-70559 **385-38-01**
Goddard Space Flight Center Greenbelt Md
SOLAR PHYSICS DATA ANALYSIS AND OPERATIONS
Robert D Chapman 301-344-5101

The objectives of this research are (1) to process analyze and interpret experiment data from flight projects and to continue this work after the immediate fundings from project offices have terminated (2) to publish in scientific literature detailed studies of phenomena gathered over protracted periods of time which reveal long-term features and correlation effects not evident during the prime data analysis (3) to engage in multidisciplinary studies comparing experiment data from other satellites and/or ground based laboratories in order to investigate in fine detail fine structure long term and secular efforts and (4) to provide additional reduced analyzed data for archive in the National Space Science Data Center During the prime analysis period many theoretical ideas about the observed phenomena are developed and the correlation of the data with other ground-based or satellite data is suggested In addition to study a given phenomena over an adequate range of the important independent variables such as solar region wavelength solar cycle etc it is necessary to process large quantities of data covering extended periods of time Thus additional data will be processed and analyzed multiexperiment studies will be made and various proposed models or theories will be critically tested by use of this data Ground-based spectroheliograph measurements will be correlated with satellite observations

W81-70560 **385-38-01**
Marshall Space Flight Center Huntsville Ala
DATA ANALYSIS, SOLAR PHYSICS
M J Hagyard 205-453-0118
(170-38-52)

The objective of this program is to analyze the solar vector

magnetic field data obtained from observations with the MSFC vector magnetograph specific objective is to infer the maximum information provided by these data on electric currents flowing through and above the solar photosphere The approach is to derive theoretical formulations which extract that part of the observed magnetic field which gives rise to currents and to compare predicted theoretical field lines with actual observations

Astrophysics Data Analysis

W81-70561 **389-41-01**
Goddard Space Flight Center Greenbelt Md
DATA ANALYSIS ASTRONOMY
J M Mead 301-344-8543
(188-41-51 188-41-55)

The objective of this research is to develop tools and techniques which will facilitate and improve the reduction analysis and understanding of astronomical data primarily through the application of computers for managing large blocks of observational information obtained at all wavelengths for stars galaxies and other extended objects This objective is being carried out through the development of (1) an Interactive Astronomical Data Analysis Facility which is designed and operated to provide astronomers with the display enhancement and analysis tools that they need to interpret their digitized images and spectra and (2) a Computerized Astronomical Data Retrieval System which provides data searches digital plots and bibliographical information for specified catalogue ID numbers positions and other parameters at ultraviolet optical infrared and millimeter wavelengths Other tasks in this RTOP include analyses of spectrophotometric observations made by space-borne astronomical payloads in order to study mass flow from stars interactions in close binaries circumstellar and interstellar matter and stellar chromospheres and the preparation of two books summarizing and evaluating observational and theoretical knowledge currently available about the physical state of O and B stars

W81-70562 **389-46-01**
Goddard Space Flight Center Greenbelt Md
HIGH ENERGY ASTROPHYSICS DATA ANALYSIS
F B McDonald 301-344-8801

The objectives of this research are (1) to process analyze and interpret galactic interplanetary Jovian and solar cosmic ray data from space flight experiments after the immediate funding project offices have ceased and for detailed studies of these phenomena involving multi-satellite data sets (2) To engage in multidisciplinary studies comparing experiment data from other satellites deep space missions and manned missions such as Skylab as well as using ground-based observations to study in detail a wide range of high energy astrophysics phenomena (3) To publish these results in the scientific literacture (4) To make the data available to the National Space Science Data Center

W81-70563 **389-46-03**
Goddard Space Flight Center Greenbelt Md
THEORETICAL HIGH ENERGY ASTROPHYSICS
R Ramaty 301-344-8715

The objectives of this research are (1) To conduct fundamental theoretical research in high energy astrophysics with particular emphasis on studies related to gamma ray X-ray and cosmic ray astronomies This program is in the forefront of theoretical research in these areas of astronomy and is pertinent to the overall observational and experimental program of the Laboratory for High Energy Astrophysics (2) To publish in the scientific literature and to present at professional meetings the significant results of such research (3) To collaborate with and support theoretical research of graduate students research associates and occasionally senior faculty members on leave from academic institutions (4) To provide theoretical support in planning space experiments in high energy astrophysics and to create the theoretical framework for the interpretation of the results from such experiments The group in the Laboratory for High Energy Astrophysics consists of three senior theoretical astrophysicists (R Ramaty F C Jones F W Stecker and four research associates (A Harding D Kazanas D Leiter and P Meszaros)

W81-70564 **389-46-04**
Goddard Space Flight Center Greenbelt Md
X-RAY ASTRONOMY DATA ANALYSIS
J H Swank 301-344-6188

Information about sources has grown steadily over the past few years with the discovery of new temporal and spectral phenomena in known sources the resolution of new sources and the identification of many with optical infrared or radio objects The data bases of our experiments contain further as yet unexamined information about these sources The data from Ariel 5 OSO-8 HEAO-1 and HEAO-2 will span over 5 years and offer complementary information on the X-ray sky including time variability of sources on time scales of milliseconds to years and spectra from 5 keV to 200 keV in many cases with simultaneous coverage by other groups down to 2 keV and up to 10 MeV We propose to study using data from the All Sky Monitor on Ariel 5 the GSFC Cosmic X-Ray Spectroscopy Experiment on OSO-8 the HEAO A2 experiment and the Solid State Spectrometer on the Einstein Observatory sources showing yet unstudied variability sources whose spectra have not been understandable with simple models spectral-temporal correlations best studied with multiple observations and models recommended by recent theoretical work and observations in other wavelengths These experiments also provide information on the detectors particle background which would be of use to future missions

Astrophysics Explorer Studies

W81-70565 **685-20-06**
Goddard Space Flight Center Greenbelt Md
EXTREME ULTRAVIOLET EXPLORER
Samuel Willis 301-344-8566

The objective of this RTOP is to provide a detailed study of the 4 telescopes with detectors and star camera in the trapezoidal Euve configuration The study will include the writing of detailed execution phase specifications The study to be funded through UCB must be done in sufficient detail to assure that the follow-on experiment hardware can be procured within the allocated cost The Euve spacecraft described in the Euve Preliminary Execution Phase Project Plan (PEPPP) will be studied in sufficient detail to assure that the spacecraft hardware can be procured within the allocated cost The study should examine in detail all aspects of launch and retrieval The study should also include the writing of detailed execution phase specifications

W81-70566 **685-20-08**
Goddard Space Flight Center Greenbelt Md
COSMIC BACKGROUND EXPLORER (COBE)
G W Longanecker 301-344-7751

The objective of the Cosmic Background Explorer (Cobe) is to further the knowledge of science in the area of astrophysics more specifically observational cosmology Cobe will make a definitive exploration and study of the diffuse radiation of the universe between the wavelengths of 1 micron and 13 mm This band includes the 3K cosmic background radiation thought to be the residual radiation from the Hot Big Bang which started the present expansion of the universe It also includes the infrared region from 1 micron to 300 microns where the diffuse radiation of the universe has yet to be detected This infrared band may include a large portion if not the dominant part of the energy content of the universe including the radiation from primeval galaxies A 1 year long mission is envisioned during which time the entire celestial sphere will be observed at least twice In support of these objectives GSFC has established a Cobe Systems Definition Phase Project It is responsible for detailed project definition They will start with the Preliminary Execution Phase Project Plan as a primary product and will produce an Execution Phase Project Plan

W81-70567 **685-20-11**
Goddard Space Flight Center Greenbelt Md
X-RAY TIMING EXPLORER (XTE)
William Hibbard 301-344-7697

The objective of this RTOP is to develop the technical and scientific basis for an X-ray Timing Mission to be proposed for

flight in FY-86 or FY-87 The Explorer class mission will observe X-ray sources with instruments having high temporal resolution to complement X-ray data from HEAO and the planned Advanced X-ray Astrophysics Facility programs A cooperative program with the Netherlands Agency for Aerospace Programs (NIVR) is under serious consideration The approach will be to establish a science definition team that will provide science planning for the mission and will identify system requirements and typical instrument characteristics A preliminary system design will be produced to demonstrate feasibility, provide a basis for cost estimating and support the Announcement of Opportunity to be issued by NASA Headquarters The general approach to the cooperative program is for the NIVR to build the spacecraft and NASA to manage the science however a specific division of responsibilities will not be established before November 1980 A final decision on the cooperative venture is anticipated in early-1981 and a formal agreement 1 year later

Sounding Rockets -- Solar Terrestrial Experiments

W81-70568 **828-11-36**
Goddard Space Flight Center Greenbelt Md
SOUNDING ROCKETS MAGNETOSPHERIC PHYSICS EXPERIMENTS
James P Heppner 301-344-8797

The objective is to perform measurements that will lead to an understanding of the interactive processes that occur between neutral gases plasmas, energetic particles and electric fields in the atmosphere ionosphere and near earth magnetosphere Emphasis is placed on measurements and experiments that utilize the unique characteristics of sounding rocket trajectories and/or the low cost quick reaction sounding rocket approach which permits program flexibility This approach has logically been extended to include (1) piggyback experiments on the orbiting upper stage of two stage Delta vehicles (2) experiments involving sounding rocket flights in association with simultaneous satellite measurements in selected geometrical coincidence between trajectories (3) flight testing of new instrumentation and measurement techniques and (4) shuttle ejection of low cost rocket type payloads in the EOP (experiment of opportunity) mode

W81-70569 **828-11-38**
Goddard Space Flight Center, Greenbelt Md
SOUNDING ROCKETS EXPERIMENT
Robert D Chapman 301-344-5101

The sounding rocket program provides unique capabilities to conduct a broad range of scientific investigations The program is particularly important for the development and demonstration of the merit of new instruments for shuttle flights and of prototype instruments for satellites Futhermore the short lead time and program flexibility make it possible to follow up new discoveries and to study particular phenomena on the Sun and in the Earth s atmosphere Extreme ultraviolet spectra (EUV) of the Sun are a valuable tool for determining the true physical conditions in the solar corona Of particular interest are the determination of the flow of matter and energy from one region to another in the corona For this purpose we need to know the coronal density temperature, gas velocity and radiation field The work under this task is directed toward the development and flight on rockets of instruments for determining these four physical parameters in the corona A better determination of the characteristics of the solar corona is necessary in order to discover the paradoxical reasons why a coronal gas temperature of more than one million degrees can be maintained by energy from a region whose temperature is only five thousand degrees These measurements are also important for determining the origin of the solar wind which may arise from regions of open magnetic field

W81-70570 **879-11-46**
Goddard Space Flight Center Greenbelt Md
SOUNDING ROCKET EXPERIMENTS (HIGH ENERGY ASTROPHYSICS)
E A Boldt 301-344-5853

High energy astrophysics (especially X-ray astronomy) is a rapidly evolving field of research, both scientifically and technically Our exploitation of the capabilities of short lead time planning flexibility accurate pointing and extremely high telemetry rates (most important) afforded by rocket-borne experiments are major factors in our success to date a vigorous elaboration of this activity is now necessary for continuing to make timely and important contributions that complement our satellite missions and for the effective planning of advanced future missions This involves experiments with systems incorporating newly developed spectrometers X-ray concentrators and imaging devices

Sounding Rockets--Astrophysics

W81-70571 **879-11-41**
Goddard Space Flight Center Greenbelt Md
SOUNDING ROCKETS EXPERIMENTS (ASTRONOMY)
T P Stecher 301-344-8718

The astronomical sounding rocket program provides a unique capability to conduct a broad range of scientific investigations The program flexibility and short lead time make it possible to observe unusual physical phenomena for which satellite instrumentation is not available The program flexibility makes it possible to expeditiously follow-up discoveries as well as to provide tests and calibrations of satellite instrumentation This unique capability is exploited by obtaining one of a kind observations of those types of astronomical phenomena that do not need large amounts of repetitive data to delinate their physical processes Many new types of observations are now possible because of recent technical advances in both attitude control and new detectors These observations are necessary in order to understand and analyze many properties of the interstellar medium stars nebulae and peculiar galaxies The present objectives are to develop payloads to obtain ultraviolet images of the weak sources now accessible as a result of improved pointing devices Old payloads will be improved and used again and new payloads will be developed to take advantage of modern sensors and image intensifiers The properties of galaxies and peculiar galaxies will be studied by means of their ultraviolet images Procedures for absolute photometry of the stars and galaxies will be investigated All instrument development will be done in such a manner that the instruments can be used on Spacelab or as Shuttle Experiments of Opportunity (EOP)

OFFICE OF SPACE TRACKING AND DATA SYSTEMS

Supporting Research and Technology

W81-70572 **310-10-23**
Goddard Space Flight Center Greenbelt Md
SOFTWARE ENGINEERING TECHNOLOGY
F E McGarry 301-344-5048
(310-10-26)

The objective of this RTOP is to identify evaluate and refine software engineering technology as applied to three disciplines of software development management and maintenance The software engineering technology to be studied includes software methodologies (such as design techniques structured implementation techniques and design evaluation techniques) software tools (such as management support tools code auditors and analyzers and automated design tools) and software support models (such as resource estimation models or reliability estimation models) The identified methodologies are intended to significantly reduce the overall life cycle costs of the software within the Mission and Data Operations area The approach to

attain the stated objectives includes the establishment of a laboratory environment through which the identified areas of software technology can be investigated measured and refined under suitable conditions The laboratory will support the research effort in the area of software development, management and maintenance Within the laboratory environment candidate technologies will be identified appropriate measures to be used in the evaluation process will be developed a data collection scheme will be identified and the experiments will be conducted where the candidate methodologies will be applied to software development and maintenance tasks This is a systems level RTOP supporting the areas of TDRSS Operations Mission Support Computing and Mission Operations

W81-70573 **310-10-26**
Goddard Space Flight Center Greenbelt Md
ATTITUDE/ORBIT SYSTEMS TECHNOLOGY
J Teles 301-344-7999
(541-01-16 310-40-39 310-20-33 310-20-37 310-20-27 310-40-26)

The objective of this RTOP is to develop evaluate and demonstrate new technology for attitude and orbit determination/prediction/analysis for both ground-based and onboard applications including algorithms techniques software and hardware The technology developed under this RTOP supports the Space Tracking and Data System in the areas of spacecraft data acquisition TDRSS Operations Mission Support Computing and data processing Various techniques algorithms and filters will be developed and compared for their applicability to onboard navigation using TDRSS data Current techniques will be evaluated for trajectory modeling studies Techniques for refining current models and formulating new models will be developed Multispectral scanner and thematic mapper data will be added to the attitude analysis system and analyzed using various filters A system will be developed to analyze image correction techniques A prototype autonomous orbit determination system will be developed analyzed evaluated and refined A prototype autonomous attitude determination system development will begin Detailed hardware requirements and configuration plan and detailed design of the transponder modifications and Doppler extractor will be developed and an overall experiment detail design will be initiated for an autonomous navigation flight experiment

W81-70574 **310-10-42**
Goddard Space Flight Center Greenbelt Md
PRECISION TIME AND FREQUENCY SOURCES
Victor S Reinhardt 301-344-5946
(644-03-15)

The objectives of the RTOP are to develop improved frequency and time standards to improve existing hydrogen maser frequency standards and to develop associated time and frequency distribution and measurement systems for VLBI and near Earth and deep space tracking Both the NR and NP masers will continue to be upgraded Major improvements planned are an integral quartz cavity-storage bulb for the NR masers and reduction in the magnetic sensitivity of the NP maser Work will continue on a low cost hydrogen maser Next year the maser will be designed in detail and some of the hardware used will be procured or fabricated and tested For hydrogen maser operational support a portable field test kit will be developed The external bulb hydrogen maser will be operating by next year and will undergo extensive testing and evaluation The modular frequency and time distribution and measurement system has been developed Using this system the frequency combiner/selector and the data acquisition system will be completed and preliminary work on the remote distribution and measurement system will be begun

W81-70575 **310-10-60**
Jet Propulsion Laboratory Pasadena Calif
RADIO METRIC ANALYSIS, DEMONSTRATION AND INSTRUMENTATION DEVELOPMENT
C L Thornton 213-354-2244
(310-10-61 310-10-62 310-10-63 310-10-64)

The broad objective of this RTOP is development of the advanced radio metric systems employed by the Deep Space Network for spacecraft navigation and radio science The requirements which will be placed upon the navigation system by proposed future deep space missions are expected to be stringent Thus, one of the major goals of this RTOP is to identify and investigate new radio metric techniques useful for navigation Current attention is focused on development and demonstration of Very Long Baseline Interferometry (VLBI) navigation concepts The technique having the highest potential accuracy is Delta VLBI a differential (spacecraft to quasar) angular measurement scheme which permits spacecraft navigation relative to angularly nearby quasars Specific objectives of Delta VLBI include (1) demonstrate 50 nano radian Delta VLBI angular measurement accuracy capability and (2) provide technology development required for future quasar-relative spacecraft navigation This development involves (1) identification of roughly 150 extra galactic radio sources suitable for navigation within 10 deg of the ecliptic plane (2) verification of extra-galactic reference frame stability and (3) determination of the relative orientation of the extra galactic and the planetary ephemeris (i e optical) reference frames to within 50 nano radians A related development effort involves end-to-end system studies for a wide (40 MHz) bandwidth S/X-band automated ranging system with the objective of providing 10 cm ranging in an efficient, cost-effective way

W81-70576 **310-10-61**
Jet Propulsion Laboratory Pasadena Calif
VLBI DEVELOPMENT AND ANALYSIS
J L Fanselow 213-354-6323
(310-10-60 310-10-62 310-10-62 310-10-63 310-40-74)

The broad objective of this RTOP is development of an understanding of the capabilities and limitations of very long baseline interferometry (VLBI) as a radio metric tool and reduction of the effects of error sources in the application of this technique This work is required for the DSN because it develops the technology which supports the new generations of VLBI-based *tracking systems now being considered for implementation* The FY-81 objectives are hand over to implementation a 30 cm VLBI system and initiate development of a VLBI system accurate to 1 cm The major areas of concentration will be improvements in antenna microwave calibration in water vapor measurements in software models for the Earth platform and in means of removing the effects of source structure There is need to provide the same navigation capability to the flight projects for the far outer planets that now exists for the inner planets This must come from a tenfold improvement in the accuracy of the ground-based DSN radio metric observables For missions not requiring increased navigation accuracy the improved observable accuracy should lead to reduced antenna tracking times The VLBI is one of the technologies chosen to achieve these goals This is done in two ways First, it is done directly through the application of differential VLBI measuring the angular separation between a spacecraft and a known radio source This is done under the companion RTOP 60 Second it is done indirectly through supporting differenced range and Doppler by measuring the relative station locations the difference in rate and epoch offset of station frequency standards Universal time and Earth pole motion The 30 cm VLBI system now developed sufficiently to commence transfer to implementation achieves the navigation accuracy required only by use of an intercontinental baseline The 1 cm VLBI system now to be developed will permit the same accuracy to be achieved over a shorter baseline

W81-70577 **310-10-62**
Jet Propulsion Laboratory Pasadena Calif
FREQUENCY AND TIMING RESEARCH
R L Sydnor 213-354-2763
(310-10-60 310-10-61 310-20-64 310-30-68)

Increasing navigation and radio science accuracy needs require improvements in the frequency and timing performance of the DSN from 10 to the minus 14 today to 10 to the minus 15 by the mid 80 s The goal for the late 80 s is 3 x 10 to the minus 16 for navigation and 10 to the minus 17 for certain radio science experiments Distribution systems which provide time and frequency at remote sites from a central frequency standard with negligible degradation must be developed Means of synchronizing the overseas complexes to the master station at

DSS 14 to 10 to the minus 8 seconds are necessary to achieve the required navigation accuracies Automatic monitoring and centralized control are needed to maintain the performance of and assure the reliability of the frequency and timing system To meet the goals of this RTOP five objectives are established Definitive tests and analysis of a Smithsonian Astrophysical Observatory VLG-11 maser and a GSFC NR maser will be conducted in order to recommend possible future implementation and developmental work The technology for a state-of-the-art monitor and control system including unattended operation and remote control will be developed The technologies (microwave fiber optic and satellites) for precision frequency and time distribution and synchronization within a station complex or network will be studied The approach includes demonstration of microwave cable and fiber optic frequency and time distribution systems in a field environment the investigation of a satellite system and demonstration of a VLBI system for time synchronization Performance and reliability problems of present frequency standards will be solved The approach is to characterize the problems and to design and demonstrate improved elements which minimize them Research leading to a new generation frequency standard to meet the performance and reliability goals of the late 80 s will be conducted The approach is to investigate the most promising standards including hydrogen masers, either active cryogenic or passive and trapped ion devices and to design and demonstrate the selected standard

W81-70578 **310-10-63**
Jet Propulsion Laboratory Pasadena Calif
NAVIGATION TECHNOLOGY DEVELOPMENT
M P Ananda 213-354-2804
(310-10-60 310-10-61)

The primary objectives of this RTOP are to enable the DSN to foresee near and far future radio metric challenges which arise from anticipated navigation needs in Deep Space missions and to equip the DSN with the necessary technology to meet these challenges via identification of the appropriate technology developments and implementations In order to accomplish the primary objectives of this RTOP four specific research and development themes have been established (1) drivers for radio metric technology development (2) streamlining of radio metric data processing (3) system studies for utility of data types facilities and technology and (4) orbit determination technology development The technical approach utilized by this RTOP is to identify and define specific work units under each of these themes The first theme establishes the need for advanced radio metric technology and investigates the efficient utilization of more machine requirements The second theme investigates the efficient utilization of more machine interactions and enhanced application of automation in radio metric data processing Performance of system studies for utility of data types facilities and technology is the prime feature of the third theme The fourth theme develops techniques for efficient use for navigation of the DSN supplied radio metric observables

W81-70579 **310-20-27**
Goddard Space Flight Center Greenbelt Md
NETWORK TIMING AND SYNCHRONIZATION TECHNOLOGY
A R Chi 301-344-7502

The objectives of this research are to study and develop techniques for time synchronization to coordinate time determination methods and dissemination formats to meet NASA needs and to conduct theoretical investigations and experimental tests for NASA applications The approach is to develop a satellite time transfer system with which to test a new operational concept of maintaining a clock autonomously to the required accuracy of the user in another satellite or on the ground The time transfer technique selected from this program is that developed earlier under a joint program between NASA and the Federal Aviation Administration The propagation path delay can be measured by a two-way satellite time transfer technique and removed if the signal received at the user s station is desired to be on-time relative to the ground station reference clock If the propagation path delay is known one-way time transfer technique can be used, limited in accuracy only by the uncertainty of the path delay Study results show that the system concept and preliminary hardware design are compatible with the Tracking and Data Relay Satellite System (TDRSSS) design and applicable to the new data management concept and the planned goal to achieve spacecraft autonomy

W81-70580 **310-20-33**
Goddard Space Flight Center Greenbelt Md
NETWORK SYSTEMS TECHNOLOGY DEVELOPMENT
J J Schwartz 301-344-7313

The objective of this RTOP is to investigate the applicability of new technology in the TDRSS era Selected technology will be investigated by means of feasibility studies prototype development and demonstration and by cost and reliability impact studies A major goal will be to carry out preliminary studies of a post TDRSS tracking and data acquisition system A second goal is to investigate the effect of non-Gaussian channel characteristics on TDRSS link performance and develop coding and signal designs which can optimize link performance Associated with this goal is the objective of validating the analytical predictions by means of limited hardware simulations Third an investigation will be made of wideband data matrix switches and transmission lines using fiber and integrated optics technology The feasibility of introducing this technology into the next generation switching systems will be investigated and a prototype switch developed Other areas include investigations of an integrated receiver system which would be capable of intelligent response to dynamic conditions and the feasibility of a solid state high capacity data storage system

W81-70581 **310-20-38**
Goddard Space Flight Center Greenbelt Md
SATELLITE COMMUNICATIONS TECHNOLOGY
D Wilson 301-344-5257

The objective of this RTOP is to investigate satellite communications technology for application to the NASA Communication (Nascom) Network to provide the best communications services at the lowest cost in support of programs and projects Initial efforts include (1) the development of communication control techniques which share satellite communications bandwidth between multiple facilities multiple computers at each facility and multiple users at each computer and (2) the investigation of the technical feasibility of data transmission systems operating at speeds of 88 to 100 Mbps with error rates of 1 x 10 to the minus 7th power or better utilizing domestic or international satellites C-band transponders A three-step approach is planned First a technical assessment will be made of research in advanced systems test and analyses in these areas Secondly advanced techniques that might be used in these areas will be investigated Thirdly the technical limitations will be assessed and a course of action would be recommended

W81-70582 **310-20-46**
Goddard Space Flight Center Greenbelt Md
TECHNOLOGY FOR TDRSS USER SPACECRAFT
R P Hockensmith 301-344-9067
(506-20-45)

The objective of the work under this RTOP is to achieve technological advances in radio frequency (RF) systems antenna systems and in data storage These developments will satisfy future requirements of space mission users (spacecraft and space transportation system payloads) that require near global coverage by the Tracking and Data Relay Satellite System (TDRSS) for support of the mission The approaches for accomplishing the objective are (1) to identify the basic operational communication requirements (2) investigate RF active and passive components and antenna systems that are feasible but may be a technical risk to attain the required RF performance (3) investigate methods of reducing torque noise induced into space platforms due to electromechanical steering of large high gain antennas (4) investigate methods of high density recording leading to the development of high capacity data storage systems (5) develop system designs incorporating these optimum subsystems to permit user projects to specify proven reliable hardware with a high confidence level in the performance capability, cost and required

procurement cycle and (6) exploit testing techniques that properly characterize these critical systems The successful accomplishment of the six stated approaches results in minimizing TDRS single access service and maximizing multiple access service without impacting the user missions expectations

W81-70583 **310-20-64**
Jet Propulsion Laboratory Pasadena Calif
X-BAND UPLINK DEVELOPMENT
R B Kolbly 213-354-1662
(310-10-62 310-20-65 310-30-68 310-30-70)

The broad objective of this RTOP is the development of a phase-stable multi-kilowatt automated wideband X-band uplink capability for future DSN missions This objective is being met by development of a 20 kW transmitter system operating at 7 2 GHz with 5 x 10 to the minus fourteenth power frequency stability It will be ready in mid-1983 for an X-band uplink demonstration in the DSS 13 unattended operations test bed Specific FY-81 objectives include (1) completion of the transmitter and exciter subsystem with automation but without final required frequency stability (2) a new microwave cone including a high performance X-band diplexer (3) preliminary integration with the new S-X feed cone being developed in RTOP 65 and (4) telecommunications system support for the demonstration, and continued maintenance of a super power (200 to 400 KW) X-band transmitter capability at DSS 14 for planetary radar Long term objectives include development of a simultaneous S and X-band uplink capability development of more reliable super power X-band transmitter capability development of cryogenically cooled diplexers and development of K-band (32 GHz) transmitter capability The X-band uplink provides an alternate for the congested S-band uplink and more reliable command and telemetry performance while in two-way lock near solar conjunction The wide bandwidth ranging possible with X-band uplink promises more precise navigation and radio science The high phase stability enhances the probability of gravity wave detection The automation supports the continuing test bed at DSS 13 to verify enhanced network productivity through automation and to provide protection to high power high cost components because of operator errors

W81-70584 **310-20-65**
Jet Propulsion Laboratory Pasadena Calif
ANTENNA SYSTEMS DEVELOPMENT
R Levy 213-354-3872

This RTOP develops the technology for optimizing communication capabilities of the DSN antenna system and mechanical components for application within the flight-ground communications link of NASA missions to explore the solar system Measures of communication capabilities are antenna figure of merit usable operational frequencies data transmission rates and environmental limits upon operational availability Technology goals are to optimize the ratios of communication capability to life cycle costs Advances in ground antenna performance and capabilities are developed within diversified technologies with the goal of achieving cost effective lower noise and higer efficiency performance in the X and K sub a-band frequency range Microwave technology is applied to provide dual frequency X and S-band feeds as effective alternatives to the present reflex feed systems and to investigate design and demonstrate new offset antennas that have clear apertures and shaped quasi-paraboloidal surfaces Efficiency improvements are through advancements in structural mechanical control and alignment procedures and by electronic compensation or control of the microwave surfaces Software for design and optimization is developed to facilitate the application of all technologies Objectives for FY-81 include completion of design and fabrication of dual frequency feed components, continuation of the efficiency and noise reduction studies of clear aperture designs, design and fabrication of a K-band demonstration model completion of studies of backup structures and mounts for offset antennas extension of all related design technologies to anticipate needs for K-band operations and application of these to studies for upgrading existing 64-m antennas development of new electronic and better mechanical CONSCAN techniques for precision pointing and error calibration, and initiation of studies of automated surface measurement techniques

W81-70585 **310-20-66**
Jet Propulsion Laboratory, Pasadena Calif
RADIO SYSTEMS DEVELOPMENT
R C Clauss 213-354-3013
(310-20-65)

The objective of this RTOP is the development of improved ground receiving elements of the spacecraft-ground communication link in order to meet more demanding telecomm performance requirements and achieve greater network productivity Future missions will require phase stable versatile reliable efficient low cost receiver elements which permit ultra-stable sensitive wideband simultaneous reception of two or more frequency bands at S X and K sub a-band Newer missions will also require noise temperature calibration and modeling of the propagation medium and of the DSN ground radio parameters for efficient link design One such receiving element is a multifrequency upconverter maser system operating at S X and K sub a-band (32 GHz) with one or two standard K sub a-band traveling wave masers all in one cryogenic refrigerator This single wideband unit would be available for all DSN frequencies instead of requiring three or four separate types to be supported logistically Another element is a reliable efficient long life closed cycle refrigerator to hold the 3 W cryogenic package at 4 5 Kelvins Other elements are a compact wideband K sub a-band maser cryogenically cooled tunable bandpass filters to permit ultra-low loss in-band interference rejection and a high performance wideband digital receiver Calibration and modeling of the propagation medium and DSN radio parameters requires thorough radiometer monitoring and establishment of a data base of the statistics of meteorological effects In addition a thorough analysis of benefits and tradeoffs which can accrue through use of K sub a-band must be made, and key needed technologies identified Specific FY-81 objectives are to procure and integrate an X-band parametric upconverter to complement the S-band upconverter developed and tested in FY-80 continue testing new ceramic regenerator materials for cryocoolers for enhanced refrigerator reliability continue testing gadolineum sulfate in adiabatic demagnetization to achieve high reliability 4 Kelvin refrigeration initiate development of a K sub a-band traveling wave maser initiate development of fixed rather than tunable K sub a-band cryogenic filter initiate development of a K sub a-band radiometer, and initiate development of key digital receiver technology

W81-70586 **310-20-67**
Jet Propulsion Laboratory, Pasadena, Calif
TELEMETRY TECHNOLOGY DEVELOPMENT
R A Winkelstein 213-354-3843
(310-40-74)

The objective of this RTOP is development of the technology necessary to expand the telemetry data reception and processing capability of the DSN to the 30 Msps region while maintaining or enhancing other DSN system requirements such as low rate telemetry low detection threshold and precision spacecraft radio metric measurements To accomplish this objective a developmental program was initiated which will lead to a feasibility model of a telemetry demodulator-detector assembly capable of processing telemetry signals in the region from 100 Ksps to 30 Msps The necessary test equipment and other support equipment required for this development have been developed or purchased Simultaneous with this development a commercial off-the-shelf telemetry modulator-demodulator covering approximately this data rate range has been purchased and will be evaluated These two activities will lead to a thorough understanding of the needs of the DSN concerning multimegabit telemetry and the ability of the commercial sector to satisfy these needs This knowledge can be used for a make or buy decision The specific FY-81 objectives are to evaluate the feasibility model demodulator-detector assembly completed in FY-80 evaluate the commercial modem delivered in FY-80 and develop a demonstration in FY-82 to verify compatibility of the developed multimegabit system with other DSN systems such as radio metrics radio science and antenna arraying Also in FY-81 this RTOP until now sharply focused on the development of multimegabit telemetry will

broaden to encompass coding and modulation studies to assess potential techniques for future implementation

W81-70587 **310-30-68**
Jet Propulsion Laboratory Pasadena Calif
STATION MONITOR AND CONTROL TECHNOLOGY
C F Foster 213-354-5070
(310-20-64)

The objectives of this RTOP are the development and demonstration of technology for unattended tracking station operations and the generation of a data base for assessement of the impact of unattended operations on network productivity and network life-cycle costs The approach used is the development of a test bed remote controlled unattended station at DSS 13 This test bed includes automated control of an unattended 26-m antenna transmitter and receiver subsystems and data processing subsystem Control of the equipment is from JPL This test bed has evolved over several years to include an increasingly comprehensive set of subsystems Six-month unattended receive capability was demonstrated at DSS 13 during FY-78 and FY-81 Semi-automated data processing has been installed Emphasis in FY-81 is on automation of the user-peculiar hardware within the station including subsystems for ranging VLBI and radio astronomy Additionally automation of preventive maintenance diagnostics of critical elements such as traveling wave masers is underway and will continue for several years

W81-70588 **310-30-69**
Jet Propulsion Laboratory Pasadena Calif
RFI SYSTEMS TECHNOLOGY
H C Wilck 213-354-4298

The broad objective of this RTOP is development of the technology to alleviate the radio frequency interference (RFI) problem confronting the DSN This requires development of an experimental radio frequency monitoring system to assess the RFI threat to DSN operations, and investigation of promising approaches to reduce DSN sensitivity to RFI The specific FY-81 objectives are monitoring of the RF environment at the Goldstone DSN complex development of RFI identification software development of software to build and manage an RFI event data base, demonstration of the utility of the surveillance system for RFI assessment and support of other surveillance system applications such as radio science experiments The trailer-housed RFI surveillance system will undergo extensive testing at Goldstone to demonstrate its operational capability and to allow its data collection and RFI detection software to be adapted to the characteristics of the observed RF environment of the DSN complex The data collected by the surveillance system is recorded on magnetic tape and further processed at JPL in non-real time to enable the development of RFI identification and data base management algorithms Initially observations will be made at the Goldstone Operational Support Radar (GOSR) site using the trailer-mounted circular horn antenna and S-band receiver Later the RFI trailer will be relocated beside DSS 14 and connected to a tap of the DSN s receiver for measuring internally generated RFI Future tasks for FY-82 and beyond include the upgrading of the surveillance system to 80 MHz bandwidth and X-band capability and the investigation of techniques to desensitize the DSN to RFI

W81-70589 **310-30-70**
Jet Propulsion Laboratory, Pasadena Calif
HIGH SPEED SIGNAL PROCESSING RESEARCH
G S Downs 213-354-2765

The objectives of this RTOP are twofold (1) design development building and operation of a test bed at the Goldstone DSN complex for research in high speed signal processing, and (2) application of this test-bed for real-time processing of several different classes of station users including planetary radar, real-time synthetic aperture radar (SAR) data reduction soft-decision decoding of spacecraft telemetry, short baseline interferometry for spacecraft radio metric navigation analysis of radio frequency interference (RFI) and processing for VLBI or radio astronomy Since station or complex use is typically for only one application at a time rapid automated reconfiguration of the test-bed elements permit one processor system for all of the user classes The test bed conceptual architecture consists of high speed hardware processor elements all controlled by a computer which can be reconfigured upon command to meet the different user needs During FY-81 the tasks are define the requirements of the potential user classes design the architecture of the processing system and initiate fabrication of specific elements such as a Fast Fourier Transform (FFT) chip under the large scale integration work unit Definition of the requirements of planetary radar users are already complete Definition of the SAR and decoding functions require further study of the essential algorithms Definition of the other user requirements have not been initiated

W81-70590 **310-40-26**
Goddard Space Flight Center Greenbelt Md
OPERATIONS SUPPORT COMPUTING TECHNOLOGY
C J McTavish 301-344-8447
(310-10-26)

RTOP 310-40-26 is a subsystem level RTOP currently supporting mission support computing With the inception of the TDRSS Operations Mission Contract in FY-82 the focus will shift to TDRSS Operations This RTOP addresses the evolution of Operations Support Computing Technology into the late 1980 s and beyond It accomplishes this through system studies to develop and analyze advanced concepts and system designs, and through concept test and evaluation via prototype implementation of specific capabilities in a controlled environment System studies in FY-81 will concentrate on modeling of system designs developed in FY-80 and on parametric studies involving capacity planning Two separate prototype development tasks from FY-80 are being conjoined under this RTOP in FY-81 to provide the concept test and evaluation capability required for developing and demonstrating advanced system concepts in a quasi-operational environment These tasks focus on the demonstration of human engineering and advanced operational concepts in the mission support computing environment

W81-70591 **310-40-37**
Goddard Space Flight Center Greenbelt Md
HUMAN-TO-MACHINE INTERFACE TECHNOLOGY
Walt Truszkowski 301-344-6222

The objective of this RTOP is to develop prototype natural man machine interfaces for space payload and ground systems control In this context natural means English-language-like The intention is to apply recent advances in low-cost computer/microcomputer hardware and artificial intelligence (AI) software techniques augmented with audio and touchtone I/O technology to the man/machine interface problems associated with such systems The approach to be taken is first design and implement prototype man machine interface systems capable of interacting with design engineers and scientists for the purpose of constructing man machine interfaces second augment the interfaces with audio and touchtone I/O technology third develop a man machine interface-oriented Knowledge Engineering Laboratory and use it to conduct subsystem experimental research This lab will in effect be an AI workbench which will synthesize the man/machine interface research and be the source of operational versions of the interfaces This RTOP is a system level RTOP supporting TDRSS Operations Mission Operations and Mission Support Computing

W81-70592 **310-40-45**
Goddard Space Flight Center Greenbelt Md
MISSION OPERATIONS TECHNOLOGY
R V Tetrick 301-344-8853

The Mission Operations Technology RTOP is a subsystem level RTOP the objective of which is to study state of the art hardware and software development and advanced technology concepts for application to the mission operations environment This is divided into two tasks, Control Center Automation and Distributed Command Management The Control Center Automation task will study the approaches benefits and risks to the automation of MSOCC I with specific emphasis on resource scheduling connection test operation and documentation for the MSOCC I system The Distributed Command Management task will first study available microcomputer systems and then

implement a Command Management System (CMS) local processing facility based upon the finding of that study and the SMM and DE CMS requirements

W81-70593 **310-40-46**
Goddard Space Flight Center, Greenbelt Md
IMAGE PROCESSING TECHNOLOGY
F W McCaleb 301-344-7819
(310-40-39 506-61-19)

This RTOP supports the development and utilization of image processing technology It consists of two tasks (1) optical disc technology utilization and (2) ground control point/registration control point (GCP/RCP) library system Task 1 investigates the utilization of optical disc technology as an input/output image data medium for image processing systems such as those in existence at the GSFC and as potential replacement of high density and computer tapes presently used as archival and intermediate storage Task 2 is directed to development of multisensor stand-alone and transportable GCP/RCP library system This system will on a global basis collect and store preselected digital image samples GCPs or RCPs to be used as image registration templates of references in the process of performing geodetic or temporal image registration In addition the system will be of general purpose so as to enable the collected image samples (points) to be transferred or transported from this library to any image processing system and in so doing have these points properly annotated (e g geodetic coordinates pixel size orientation etc) and formatted for use by the host system This is a subsystem level RTOP supporting data processing

W81-70594 **310-40-49**
Goddard Space Flight Center Greenbelt Md
SYSTEMS MANAGEMENT TECHNOLOGY
R L Larsen 301-344-7777

The objective of this RTOP is to develop and validate concepts and techniques which can optimize the evolution and operation of Space Tracking and Data Systems (STDS) Its major objectives are (1) the definition design and evaluation of an STDS data management accounting system on a projectized basis (2) the development of a cost/benefit assessment methodology and its application to crucial STDS design issues and (3) the formulation of a research program to explore the nature of control and decision making in large-scale decentralized systems The RTOP approach is to develop associated tools and techniques apply the techniques to representative STDS problems and evaluate both the technique and its results prior to its operational introduction in STDS The analysis of these specific problems is needed by management in order that the productivity of STDS during the 1980s will be optimized prior to its operational introduction in STDS The RTOP is a system level activity supporting spacecraft data acquisition TDRSS operationals data processing mission operations and mission support computing

W81-70595 **310-40-72**
Jet Propulsion Laboratory Pasadena Calif
NETWORK DATA PROCESSING DEVELOPMENT
R C Tausworthe 213-354-2773

The objective of this RTOP is to develop the techniques necessary for the efficient and cost-effective application of computational resources to the jobs of the DSN Information system engineering methods being devised in this RTOP will improve management control of systems development and facilitate the production of user-responsive functional requirements through detailed software design and implementation tasks The advanced systems segment of the DSN programming systems work utilizes pathfinder projects such as elements of the DSN programming system to develop and tune an information systems engineering methodology appropriate to DSN needs This methodology in turn contributes to standard practices and standard tools and languages for DSN implementation in order to improve the overall productivity of the DSN In past years this RTOP has included RFI identification control and computational module (CCM) development and software work units the first has been switched to another RTOP the second transferred to implementation and the last has been phased into the information systems methodology research work unit in this RTOP

W81-70596 **310-40-73**
Jet Propulsion Laboratory Pasadena Calif
NETWORK PRODUCTIVITY RESEARCH
J H Yuen 213-354-2081
(310-30-68)

The broad objective of this RTOP is to increase the effectiveness of DSN use of NASA resources for telecommunications and data acquisition support of flight projects and other end users This requires research at the DSN system level to assess the feasibility and cost-effectiveness of future options for improving the planetary telecommunications capability and development of economic tools to permit quantitative assessment of network productivity and cost-effectiveness The approach used in this RTOP is threefold One research at the DSN system level will assess the feasibility and cost-effectiveness of future options for improving the planetary telecommunications capability Second economic tools are being developed to permit quantitative assessment of network productivity and cost-effectiveness Finally detailed assessments will be made of specific concepts which offer promise of meeting particular DSN needs This allows the full impact of new technology or alternate methods of providing DSN services to be evaluated prior to the expenditure of large amounts of implementation funds The specific objectives of this RTOP are develop mathematical models and computer simulations of the DSN from the subassembly level to the network level for economic performance characteristics compare ten-year life-cycle costs of providing 6 db increase of X and K sub a-band telemetry capability on the spacecraft and at the DSN assessment of DSN-flight telecommunication system performance capabilities under joint-sponsorship with TSPD revise Telecommunications System Design Techniques Handbook and evaluate specific post-1990 DSN options such as optical space communication system

W81-70597 **310-40-74**
Jet Propulsion Laboratory Pasadena Calif
ARRAYED NETWORK TECHNOLOGY
A I Zygielbaum 213-354-2745
(310-20-65 310-20-75 310-30-68)

The goal of this RTOP is to provide an evolving technological basis for the development operation and utilization of arrayed DSN antennas for space telecommunications, tracking and scientific investigation The program will identify and analyze the operation and application of arrayed systems model a system or systems satisfying those needs provide the theoretical foundation to develop the technology, produce prototype control and processing hardware and software and provide a series of demonstrations of automated arrayed reception capability All aspects of the system from antenna pointing through executive control and data validation are included While pursuing the long term objective this RTOP must also in the short term provide the technology to improve the current capability of the DSN to combine signals from different antennas This cost-effective means to increase receiving aperture must be made more automatic reliable and operable The goal is to transfer an intelligent automated combining system to DSN implementation by the end of FY-83 In response to the current needs for arraying of DSN antennas (such as Voyager Uranus encounter) the RTOP will in FY-81 (1) initiate the development of an intelligent real-time combining system (2) develop the hardware and software for the accurate measurement of low SNR (3) develop techniques to array suppressed carrier signals and (4) develop techniques hardware and software to point, calibrate and measure the performance of arrayed systems To initiate the broader task of creating the technology to efficiently effectively and reliably array deep space telecommunications antennas the following will be funded (1) development of a system simulator to facilitate system and component research (2) analysis of whether and when combining should be done at carrier subcarrier or symbol level (3) analysis to determine the optimum waveform for combining and (4) measurement and analysis of the tropospheric instabilities that will affect carrier combining

OFFICE OF SPACE TRANSPORTATION SYSTEMS

Advanced Programs

W81-70598 **906-55-00**
Lyndon B Johnson Space Center Houston Tex
LARGE SPACE STRUCTURE SYSTEM ENGINEERING
Richard C Kennedy 713-483-4083

The objectives of this RTOP are to develop an understanding of space construction requirements for NASA programs of the 1980 s and to identify and develop the tools techniques ground test hardware and flight development activities necessary to insure that these programs can be implemented when approved (This activity complements the OAST funded large space structures technology activities conducted at JSC and other centers) The concept of beam machines which convert raw stock into structural components is one of the most promising candidates for the large space structures envisioned in the late 1980 s Two automated beam machine concepts continue to be researched by JSC Both systems are adaptable to composite materials which combine structural strength with a very low coefficient of thermal expansion Materials research involving magnesium lithium graphite composites will be pursued as a lightweight space structural material

W81-70599 **906-75-00**
Lyndon B Johnson Space Center Houston, Tex
SATELLITE SERVICES
Richard C Kennedy 713-483-4083

The Shuttle mission model identifies many payload deployment and retrieval requirements beyond the capability of the basic Shuttle system Satellites such as the Multi-Mission Satellite (MMS) and Space Telescope require periodic servicing Studies of some future space systems show that longer operational lifetimes are necessary for long duration low-cost operation and that a servicing capability including maintenance repair and refurbishment will be required Studies of possible flux densities of non-functional satellites and debris in the year 2000 time period show results indicating potential hazards to space flight It is now timely for the development of a satellite services capability for a cost effective means of meeting early payload needs and to meet longer term requirements for dealing with maintenance and satellite removal requirements This RTOP includes the definition design development fabrication and flight testing for engineering and operational verification of key elements of a satellite services system These services include deployment and retrieval of payloads earth-return and general satellite support

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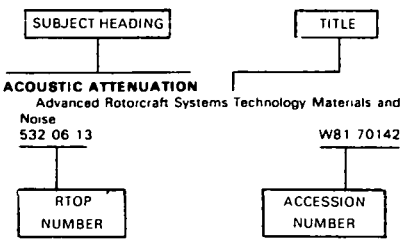

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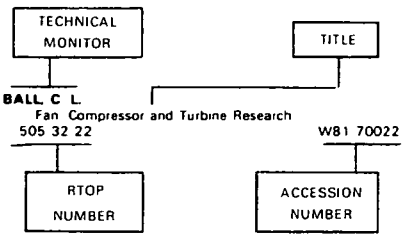

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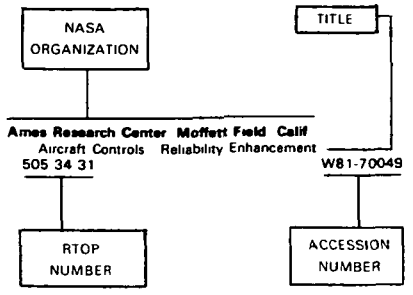

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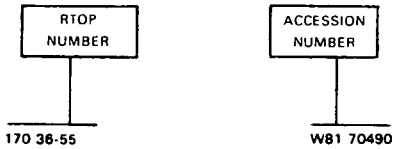

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